Australian Government

Department of Industry, Innovation, Science, Research and Tertiary Education

APS200 Project

The Place of Science in Policy Development in the Public Service

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Executive Summary

The Australian Public Service (APS) is increasingly tasked with solving complex policy problems that require significant input from science in order to address them fully and appropriately. Policy making within the APS needs to be based on a rigorous, evidence-based approach that routinely and systematically draws upon science as a key element.

The Australian Government's investment in science, research and innovation capacity supports a long-term vision to address national challenges and open up new opportunities. This investment is also significant, with the Commonwealth providing $8.9 billion to support science, research and innovation in 2012-13. There is an opportunity to harness this investment to address complex societal challenges, by ensuring that scientific research and advice is more effectively incorporated in the development of evidence-based policy.

There is an opportunity for policy makers to make better use of the science capacity provided by our science institutions, including publicly funded research agencies and other science agencies, universities, Cooperative Research Centres and Medical Research Institutes. There is also an opportunity to capitalise on the willingness of scientists to contribute their research results to the policy making process.

The APS200 project on *The Place of Science in Policy Development in the Public Service* systematically reviewed the ways in which scientific input is used to inform policy development in the APS. This report provides departments and agencies with practical and useful strategies to maximise the use of science in policy development. Ultimately, the project has sought to arrive at an end-state where policy making within the APS draws on the best available scientific evidence on a routine and systematic basis.

The project found that there are a range of potential issues associated with the process of incorporating science in policy development. Broadly these issues/challenges and related opportunities can be divided into five categories:

- **Timeliness** – the timeliness of scientific evidence is critical to its uptake in policy; the right evidence must be seen at the right time by the right people; both the APS and the science community need to prepare for the policy challenges of the future so that scientific research is available when needed.

- **Cultural** – there are cultural challenges that can impede effective interaction between scientists and policy makers; it is important that scientists are policy literate and that policy makers are science literate and that there is sufficient incentive for collaboration between the two.

- **Relationships** – the nature of interactions and communications between scientists and policy makers is critical to ensuring the uptake of science in policy; it is important to support effective networks, knowledge translation and knowledge brokering.

- **Timeframes** – the challenging timeframes associated with policy development can impact on access to and uptake of science at all stages of the policy process; strategies are needed to facilitate access to the right advice within the right timeframe.

- **Access** – there is a need to facilitate access to and use of scientific data and research services to support policy; government can maximise its investments in research and data by encouraging data access, sharing and integration to support further research and policy development.

The objective of this report is to provide a systematic approach that seeks to overcome these key challenges and harness opportunities for incorporating science in policy development. The project explored practical approaches to negotiate the challenges that affect the interaction between science and policy and develop pathways that support the transfer of scientific research into policy development and decision-making.

The key findings and recommendations of this report focus on best practice approaches and identify key strategies and actions to implement in order to encourage the uptake of science in future policy development. The recommendations are arranged under five intersecting themes.

Recommendations

1. Systematic approach to science in policy

A systematic approach is required to ensure that science is included as a key element in evidence-based policy and evaluation.

1.1 Departments to review existing business planning and policy development frameworks and incorporate principles, strategies or processes to facilitate the systematic inclusion of science in evidence-based policy, program design and evaluation.

1.2 The Department of Industry, Innovation, Science, Research and Tertiary Education (DIISRTE) to coordinate a community of interest amongst policy departments, in order to sustain ongoing collaboration and sharing of best practice to support the incorporation of science in evidence-based policy.

2. Future science priorities

Identifying and prioritising future science and policy needs will prepare the APS to develop robust science-based policy.

2.1 The Commonwealth to consider its future science research priorities for policy and to communicate those needs to the science community. There may be a role for the Australian Government, or the Chief Scientist for Australia, in issuing a statement of Commonwealth policy research priorities, either separately or in conjunction with other priority setting exercises.

3. Human capability in science and policy

Effective science-based policy requires the development of appropriate human capability to ensure that policy makers understand science and researchers understand policy, including the limitation of both 'worlds'.

3.1 The Australian Public Service Commission (APSC) to take the lead in promoting and developing training, mobility and recruitment initiatives to enhance the scientific literacy of APS leaders and policy makers.

3.2 Departments and science agencies to promote or establish mobility programs that seek to provide policy makers with the opportunity to work in science related roles and scientists with the opportunity to work in policy related roles.[1]

3.3 Science agencies to incorporate training and other development opportunities within learning and development frameworks that aim to help scientists understand policy development and the role of science in policy from the perspective of policy makers.

3.4 Departments to implement workforce planning and recruitment strategies that consider existing and future human science capability and skill requirements.

3.5 DIISRTE to explore options to strengthen the linkage between science and policy by encouraging and rewarding effective collaboration between researchers and policy makers.

4. Relationships and communication

Effective and appropriate science-policy relationships and communication will facilitate the uptake of scientific evidence and advice in policy development.

4.1 Portfolios to promote or establish science liaison functions to facilitate and coordinate communities of practice, knowledge translation and knowledge brokering in domain areas.

4.2 Departments to review and enhance existing science advisory mechanisms to facilitate the uptake and acceptance of robust evidence-based science in policy initiatives.

5. Knowledge and data management

Knowledge management, integration and sharing within and across the public service and science agencies can facilitate access to and use of data and research services to support policy.

5.1 Departments and science agencies to develop knowledge management strategies, processes or practices that promote improved information management and facilitate access to scientific data, resources, expertise and advice.

5.2 Relevant agencies (e.g. OAIC, DIISRTE, GA, ABS), in conjunction with research organisations, to review current initiatives and, if appropriate, develop a project proposal for the management of publicly funded research data to facilitate data access, sharing and integration across the research and public sectors.

[1] Science agencies refers to Commonwealth agencies having substantial research expertise that provide scientific input to policy development, including publicly funded research agencies and other relevant agencies (e.g. the Australian Bureau of Statistics). Refer to the list provided at Appendix 2.

Part A. About the Project

1. Introduction

The world, and Australia with it, is faced with increasingly complex challenges and opportunities, most of which require significant input from science in order to address them fully and appropriately. Policy making is increasingly reliant on scientific advice to address complex problems which cut across many policy and research domains.

It is widely accepted that the best practice approach to policy development is informed through a robust evidence base derived through systematic evaluation of the available information.[2] As noted in *Ahead of the Game: Blueprint for Reform of Australian Government Administration* (the 'Blueprint'), there is a need to affirm "the practice whereby the best evidence-based policy and delivery options are put forward to Ministers".[3] Yet there remains scope to improve the development of evidence-based policy through a greater appreciation of how science can contribute to better public policy outcomes.

There is an opportunity for policy makers to make better use of the science capacity provided by our science institutions, including our publicly funded research agencies (PFRAs), universities, Cooperative Research Centres (CRCs) and Medical Research Institutes (MRIs). There is also an opportunity to capitalise on the willingness of scientists to contribute their research results to the policy making process.

The APS200 project on *The Place of Science in Policy Development in the Public Service* systematically reviewed the ways in which scientific input is used to inform policy development in the Australian Public Service (APS). The project explored practical approaches to negotiate the challenges that affect the interaction between science and policy. The key findings and recommendations of this report then focus on best practice approaches and identify key strategies and actions to implement in order to encourage the uptake of science in future policy development. The objective is to ensure that policy making in the APS draws on the best available scientific evidence on a routine and systematic basis.

2. The Australian science system

The Australian Government's investment in science, research and innovation capacity supports a long-term vision to address national challenges and open up new opportunities.[4] This investment is also significant, with the Commonwealth providing $8.9 billion to support science, research and innovation in 2012-13, which includes investment in the research activities of PFRAs, as well as transfers to business, higher education and multi-sector research activities. The government has an interest in harnessing this investment to address complex societal challenges, including ensuring that the interactions between the science community and policy makers operate effectively to support the transfer of scientific research into policy development and decision-making.

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[2] Nutley S. *Bridging the Policy Divide: Reflections and Lessons from the UK*. April 2003. http://www.treasury.govt.nz/publications/media-speeches/guestlectures/nutley-apr03

[3] http://www.dpmc.gov.au/publications/aga_reform/aga_reform_blueprint/docs/APS_reform_blueprint.pdf. 45.

[4] *Powering Ideas: An Innovation Agenda for the 21st Century*. 2009. http://www.innovation.gov.au/Innovation/Policy/Documents/PoweringIdeas.pdf

The interactions between policy makers and decision-makers and the science community are complex. Figure 1 provides a visualisation of the organisation of key actors within the Australian Science System.[5] Government, through departments and funding agencies, provides the funding and support to underpin the science system. Within the system there are numerous science suppliers, including PFRAs, universities, CRCs and MRIs, which receive significant amounts of government funding. Government departments also have established formal relationships with coordination bodies and funding agencies.

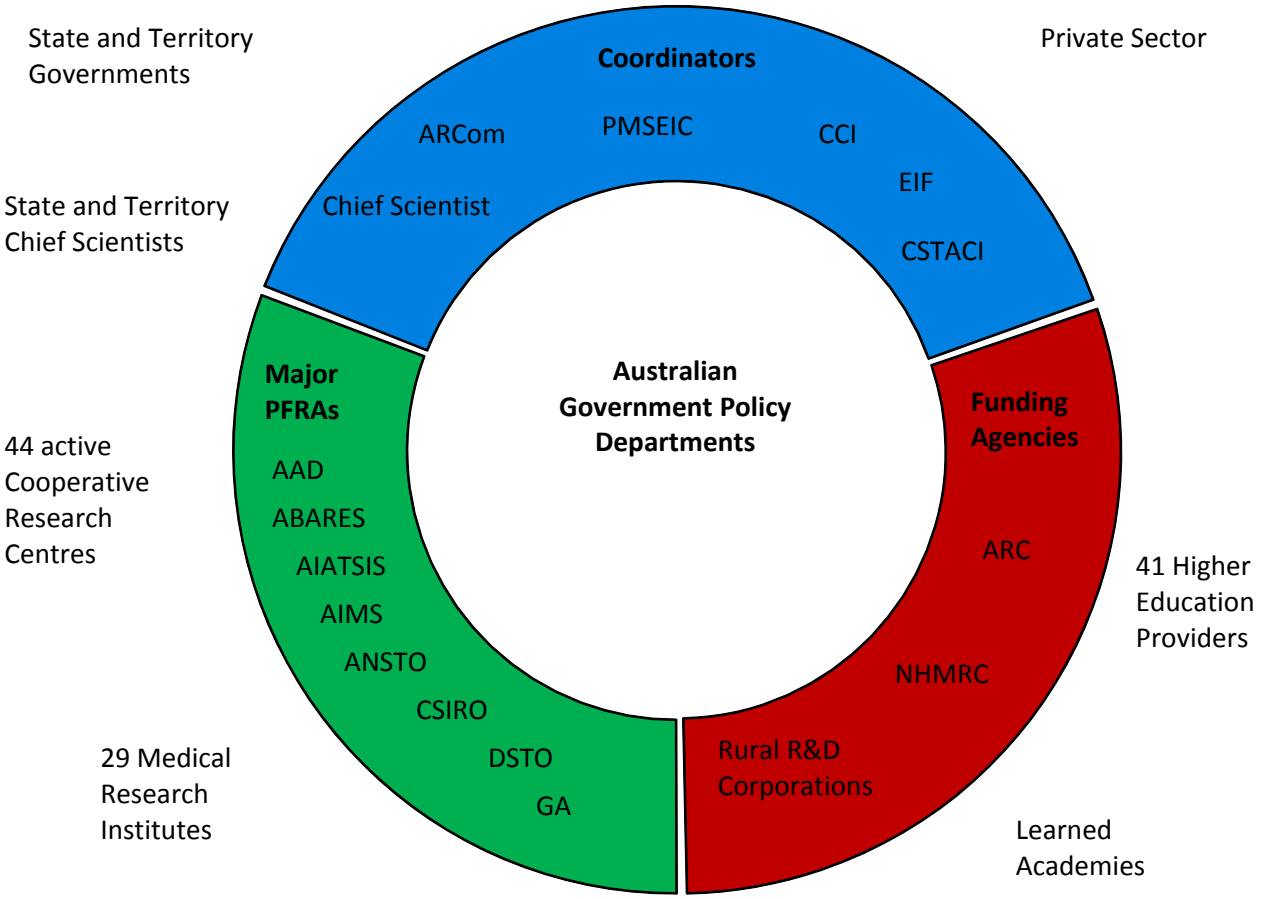

Figure 1: The Australian Science System

Within the Commonwealth government, scientific research is undertaken by PFRAs, such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), the Defence Science Technology Organisation (DSTO) and Geoscience Australia (GA).

Appendix 2 provides a list of Commonwealth science agencies having substantial research expertise that provide scientific input to policy development, including PFRAs and other relevant agencies (e.g. the Australian Bureau of Statistics).

[5] Routine data collection, policy related studies, market research and activities that are ancillary to R&D are excluded from the definition of R&D used to inform the agencies that are reported in the Science, Research and Innovation Budget Tables. This list of agencies is used as the basis for the PFRAs included in Figure 1. Consequently the ABS is not included here. See Appendix 1 for a list of abbreviations.

Commonwealth science agencies already have a variety of tried and tested mechanisms for supplying scientific advice to inform policy development, implementation and evaluation. Science agencies often hold unique positions as internal, trusted advisors to the Australian Government and, in some cases, are structurally embedded within policy departments, albeit with their own independent research responsibilities and roles (e.g. ABARES and DSTO).

Major funding agencies also have a role in providing advice to the Australian Government that is relevant to policy development, implementation and evaluation. For example, the Australian Research Council (ARC) is responsible for providing advice on research matters and collects metrics to evaluate the quality of Australian research through the Excellence in Research for Australia (ERA) initiative. The National Health and Medical Research Council (NHMRC), as well as having primary responsibility for funding health and medical research in Australia, also develops health advice and evidence-based guidelines for the Australian community, health professionals and governments.

The independent role of the Chief Scientist for Australia ('the Chief Scientist') works together with the Department of Innovation, Industry, Science, Research and Tertiary Education (DIISRTE) to provide both science and science-policy advice to government. The Prime Minister's Science, Engineering and Innovation Council (PMSEIC) provides short-term and over-the-horizon advice on science and technology directly to the Prime Minister and relevant Ministers. The Chief Scientist is Executive Officer of PMSEIC. The Australian Research Committee (ARCom) has been established to provide integrated and strategic advice on future research investments, including in the areas of human capital, infrastructure and collaborative activities. The Chief Scientist is the Chair of ARCom.

There are a variety of mechanisms available to increase the evidence base underpinning policy, and specifically, to access and incorporate science into policy development. Increasing recognition of these mechanisms across government and ensuring government has the expertise and procedures in place to maximise their utility are the challenges addressed in this project.

3. About the APS200 project

This project comes as part of a broader effort by government and the public sector to establish better connections between the public sector and policy advice informed by evidence.

Origins of the project

The APS200 is the senior leadership forum for the APS. The APS200 has a leading role in communicating the vision of the future APS and building the understanding, engagement and commitment of staff to the reform agenda. As well as undertaking specific policy or change management projects commissioned by the Secretaries Board, APS200 members bring forward ideas and proposals for consideration and provide feedback on the progress of the reform agenda and APS culture, attitudes and beliefs.

The Blueprint outlines a comprehensive reform agenda supported by specific areas of action to ensure the APS can meet the challenges faced by a modern public service. It identifies four broad areas where current performance can be strengthened, including Enhancing Policy Capability (Reform 3).

The Enhancing Policy Capability reform agenda highlights the need to strengthen strategic policy, build partnerships with academia, research institutions, the community and private sector, and improve policy implementation.

In 2011, the Secretaries Board endorsed a new APS200 project on *The Place of Science in Policy Development in the Public Service*.[6] The project sponsor is the Secretary of DIISRTE.

Project objectives

The project aimed to review systematically the ways in which scientific input is used to inform policy development and to codify the realities of this process. For the purpose of this project the focus is on policy development from the perspective of the APS. It provides recommendations on practical approaches to negotiate the complexities and possible initiatives to encourage the uptake of science in future policy development.

This project has specifically sought to:

- examine existing policy formulation processes in the APS to consider where scientific input could be incorporated into the policy cycle
- develop case studies and conduct targeted interviews and consultations that identify opportunities or impediments to scientific input into policy making
- identify best practice approaches to include effective mechanisms for incorporating scientific input into the policy development process
- report to the APS200 on possible frameworks identifying where science can best be incorporated into the policy development process.

This report is the result of discussions with Commonwealth agencies and relevant stakeholders in the science community on the current state of evidence-based policy and how science may best be used to help resolve complex policy problems.

This report defines science in its broadest sense as embracing all forms of knowledge, and all branches of inquiry, to the extent they are informed by an evidence base. This approach was informed by the United Kingdom Science Council's definition of science as: the pursuit of knowledge and understanding of the natural and social world following a systematic methodology based on evidence.[7]

Project governance

The project was directed by a cross-portfolio Steering Committee, which consisted of selected deputy secretaries, agency equivalents and the Chief Scientist. The Steering Committee met at key milestones to review progress and direction of the project and advise on next steps. The Steering Committee reported to the Secretary of DIISRTE as the project sponsor.

The project was also supported by a cross-portfolio Reference Group, comprising Senior Executive Service Band 1 equivalent officers or their delegates from various agencies, who were selected for their interest in and ability to provide insights into best practice and/or the

[6] The project is also consistent with the 2010 Management Advisory Committee report on fostering innovation in the APS, see http://www.innovation.gov.au/Innovation/PublicSectorInnovation/Documents/Empowering_Change.pdf
[7] http://www.sciencecouncil.org/definition

tensions associated with the provision of scientific advice for policy development. The Reference Group was responsible for providing substantial input to the evidence base and directing the operational conduct of the project. The Reference Group reported to the Steering Committee and was supported by the Project Team.

The project was delivered by the Project Team based in the Science Policy Branch in DIISRTE. CSIRO and DSTO also contributed staff time to the project through a formal secondment and an informal *ad hoc* arrangement respectively.

The membership of the Steering Committee, Reference Group and Project Team is provided at Appendix 3. Other contributors to the project are acknowledged at Appendix 4.

Methodology

The evidence base for this project was informed and developed through a process of information gathering, consolidation, testing and refinement. The initial findings were driven by discussions held at Steering Committee and Reference Group meetings. Their experiential knowledge and perspectives as policy makers operating at the science-policy interface provided the initial information base for the project.

The Reference Group, supported by the Project Team, undertook a thorough and detailed analysis of the issues and barriers affecting the uptake of science at each stage of the policy cycle and identified strategies that could assist in overcoming challenges and pursuing opportunities. This mapping exercise was supplemented by case studies which provided specific examples of the incorporation of science into policy. The case studies provided the evidence base of existing practice, which was used to categorise common issues into broad thematic areas.

After this initial information gathering phase, a number of areas required further information to consolidate the evidence base and further test and refine key findings. To support this process, three targeted consultation processes were undertaken.

First, Professor Linda Botterill from the University of Canberra conducted a series of semi-structured interviews with individuals operating primarily at the supply-side of science into policy. The interviews lasted for between 40 minutes and an hour and were free flowing, allowing the participants to reflect at length on their experience of the relationship between scientific research and the policy process.

Nineteen individuals were interviewed in total. Participation was on the basis that interviewees would not be individually identified. The participants were broadly categorised as ‘supply-side’, that is researchers, or ‘demand-side’, that is policy makers. The sample was deliberately biased towards the supply-side, however participants from government scientific agencies saw themselves as sitting somewhere between the two. The findings from these interviews further supported and refined a number of the themes already identified and offered new insights. For example, Professor Botterill’s report to the Reference Group highlighted the importance of ‘boundary players’ in mediating between the science and policy arenas.[8]

Second, Mr Paul Harris from the HC Coombs Policy Forum at the Australian National University undertook a series of interviews with program managers from across

[8] Botterill, L. *Results of targeted consultations.* Report submitted to the APS200 Project on the Place of Science in Policy Development. May 2012.

Commonwealth agencies to ascertain the extent to which these programs seek to support stronger links between science and policy. Mr Harris's work provided a new lens to view the issues associated with the supply and demand of science into policy. In particular, it provided insights on issues associated with program design and evaluation that are relevant to ensuring that the outputs of government science programs are accessible and useable for integration into policy. Mr Harris also contributed additional material for the project, including case studies on the National Environmental Research Program (NERP) and the role of the Australian National University's Institute of Public Policy, including the HC Coombs Policy Forum.

Third, the Project Team undertook a series of targeted consultations with selected stakeholders to further investigate, test and refine key findings, including consultations on implementation options and recommendations.

A list of contributors to the project, including organisations that contributed case studies or were otherwise interviewed or consulted, is provided at Appendix 4.

This project has also been informed by DIISRTE's 2011 graduate project on *Improving Collaboration between Researchers and the Australian Public Service* and supported many of the findings of that project's report.[9]

[9] DIISRTE. *Improving Collaboration between Researchers and the Australian Public Service*. 2011.

Part B. Findings and Recommendations

1. Systematic approach to science in policy

A systematic approach is required to ensure that science is included as a key element in evidence-based policy and evaluation.

The APS already utilises a range of processes and mechanisms, both formal and informal, to incorporate science in policy. There are further lessons to be learnt from experience internationally. There is an opportunity to codify and capture the best practice approaches, based on real experiences of policy makers and scientists both domestically and abroad, to support the systematic inclusion of science as a key element in evidence-based policy.

Each of the recommendations arising from this project seek to support the systematic and routine inclusion of scientific advice in the policy making process. The two recommendations in this section are overarching in that they seek to capture the full gamut of lessons learned through this project, as well as to sustain effort into the future. The first recommendation, therefore, is that departments consider how best to incorporate the key findings from this project, in the form of principles, strategies and best practice approaches, into existing business planning and policy development frameworks (see recommendation 1.1). In so doing, each department will contribute to and facilitate the systematic inclusion of scientific input and advice in evidence-based policy, program design and evaluation going forward.

Recommendation 1.1
Departments to review existing business planning and policy development frameworks and incorporate principles, strategies or processes to facilitate the systematic inclusion of science in evidence-based policy, program design and evaluation.

Recommendation 1.2
DIISRTE to coordinate a community of interest amongst policy departments, in order to sustain ongoing collaboration and sharing of best practice to support the incorporation of science in evidence-based policy.

To support these recommendations, this section provides a broad overview of the key findings from the project, with a particular focus on identifying strategies for incorporating science into policy, mapped against the policy cycle (as summarised in Table 1, on page 12). These strategies broadly capture existing best practice approaches as identified through the course of the project. This section also provides the broad context for subsequent sections and their specific recommendations.

In order to continue to encourage and facilitate the systematic inclusion of science in evidence-based policy, it is recommended that a community of interest be sustained beyond the life of this project (see recommendation 1.2). This section explores the concept and potential shape of a community of interest in more detail below.

Issues, challenges and opportunities

The project found that there are a range of potential issues associated with the process of incorporating science in evidence-based policy. Broadly these issues/challenges and related opportunities may be divided into five categories:

- **Timeliness** – the timeliness of scientific evidence is critical to its uptake in policy; the right evidence must be seen at the right time by the right people; both the APS and the science community need to prepare for the policy challenges of the future so that scientific research is available when needed.

- **Cultural** – there are cultural challenges that can impede effective interaction between scientists and policy makers; it is important that scientists are policy literate and that policy makers are science literate and that there is sufficient incentive for collaboration between the two.

- **Relationships** – the nature of interactions and communications between scientists and policy makers is critical to ensuring the uptake of science in policy; it is important to support effective networks, knowledge translation and knowledge brokering.

- **Timeframes** – the challenging timeframes associated with policy development can impact on access to and uptake of science at all stages of the policy process; strategies are needed to facilitate access to the right advice within the right timeframe.

- **Access** – there is a need to facilitate access to and use of scientific data and research services to support policy; government can maximise its investments in research and data by encouraging data access, sharing and integration to support further research and policy development.

The objective of this project is to provide a systematic approach that seeks to overcome these key challenges and harness opportunities for incorporating science in policy development. These intersecting issues are addressed through each of the subsequent sections and recommendations (see sections 2 to 5).

Incorporating science in the policy cycle

The key points of possible engagement between policy development and science can be represented in many ways. This project considered the policy process as five stages in a policy cycle (as represented in Figure 2): anticipation; formulation; consultation, adoption and evaluation.[10]

The value of the policy cycle approach is that it disaggregates complex phenomena into manageable steps, which allowed the project to map the issues, challenges and opportunities for incorporating science against each phase in the cycle. It should be noted that the use of the policy cycle approach does not mean to imply that policy development always occurs in a discrete logical and chronological sequence. Many variations to the policy development process occur in practice, with numerous feedback loops and iterations between various stages. Nonetheless, the policy cycle approach is a useful organising device for conceptualising the process and identifying the key entry points for scientific input.

[10] Adapted from the eight stage 'Australian policy process' used by Althaus, Davis & Bridgman. *The Australian Policy Handbook.* 4th ed. Sydney: Allen & Unwin. 2007.

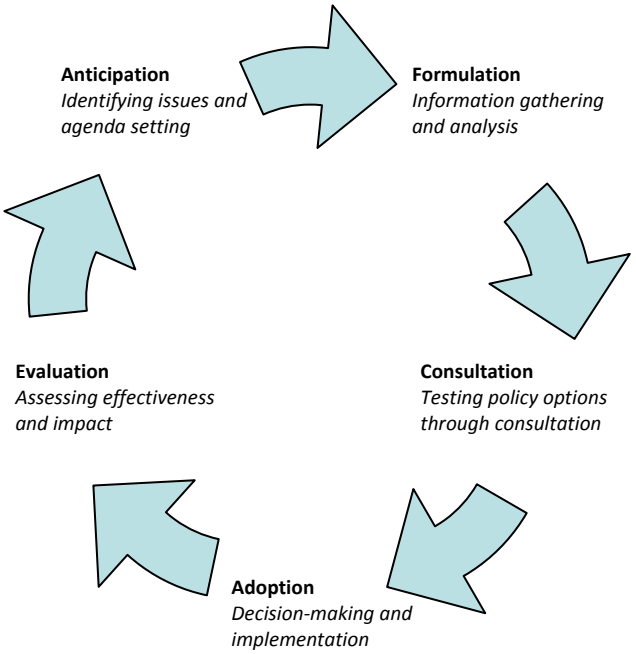

Figure 2: The Australian Policy Cycle

An overview of each stage is provided below, along with a summary of the opportunities and strategies for incorporating science, as identified through this project. Table 1 (on page 12) then summarises the key long-term and short-term strategies to support a systematic approach for incorporating science in evidence-based policy, including program design and evaluation.

Anticipation

Policy anticipation refers to identifying issues that may require a policy response. Issues may emerge on the policy agenda through pressure from issues advocates, interest groups or media coverage of a topic. New policy work can also arise through the evaluation of previous policy initiatives or be politically driven by the government of the day. The policy anticipation stage also includes long-term horizon scanning for emerging issues and forms part of preparedness, which is key to the public service being responsive and able to provide advice to government that is timely and robust.

This stage of the policy process can present challenging timeframes for responding to issues which emerge unexpectedly, suddenly or through a crisis. In such cases there is frequently a tension between the need for robust evidence, which generally takes time, and the political need for speed. There is also a risk that issues advocates will have a disproportionate influence on issues identification and the policy response. It is important therefore that policy makers have access ahead of time to trusted advisors, be they individuals, committees or science agencies, which can provide information and trusted or brokered advice on emerging issues. The importance of these relationships is further explored in section 4.

Alternatively, an issue may have a long lead time before a policy response is required, allowing the policy anticipation stage ample time for scientific evidence to be gathered through a range of mechanisms, including work by science agencies, through advisory committees or commissioned research (see section 4).

In either case, there is an opportunity for the Commonwealth to consider its future research needs for policy and communicate those needs to the science community to help prepare the evidence base for the future (see section 2). There is also an opportunity for departments to consider their future science capability, both in terms of its workforce and knowledge management strategies, and to plan and prepare for future policy work accordingly (see sections 3 and 5).

Formulation

Policy formulation refers to the information gathering and policy analysis stage, including selection of the appropriate instrument for implementing policy. The purpose is to analyse the collected information and canvass a range of options for further consideration. To assist in the gathering of information, policy makers may undertake research or use experts on a particular subject matter. Once the policy analysis has taken place and it is determined that intervention is required or likely, the most appropriate instrument for implementing the policy is selected.

In this stage, it is important that policy makers have the skills to research, analyse and evaluate scientific evidence, in order to manage uncertainty and complexity (see sections 3 and 4). It is important also that science advisors understand the role that scientific evidence plays in policy development; scientists need to be policy literate. Robust scientific evidence can assist to define the policy question being asked and help to balance the diverse consideration of other perspectives (including social, economic and environmental) which is an essential part of the policy development process.

Developing communities of practice that involve scientists and policy makers with expertise around a set of issues can assist in improving the science literacy of policy makers, thus enhancing the use of scientific evidence to underpin policy. Bringing scientists and policy together in subject-specific workshops can facilitate dialogue, educate policy makers about the underpinning science and progress policy formulation (see section 4).

Policy makers need to consider what research is needed, from whom, in what format and in what timeframe, including identifying the scientist and/or science agency that can provide the input and assist in understanding the science. Knowledge translation activities that aim to synthesise and target existing science knowledge are often appropriate to policy needs (see section 4).

In the policy formulation stage of the policy cycle, it is important to have ready access to scientific evidence, including access to scientific data, resources, expertise and advice. Knowledge management plans and strategies can facilitate access to and use of scientific evidence in policy development (see section 5).

Consultation

Consultation refers to processes where policy options are discussed and tested with stakeholders, either internal or external to government. The purpose of consultation includes testing the strength of the analysis and the feasibility of the proposed policy response. Where the policy analysis has been informed by science then this stage may be seen to test the acceptability and robustness of the underlying science base. Consultation may also offer a new opportunity to seek scientific input or advice to improve or refine the proposed policy response. Consultation can occur both formally and informally and may occur at multiple points in the policy development process.

During the consultation phase it is important to ensure that both policy makers and scientists have the skills to understand and communicate the underlying science, including the risks and implications of contested science. Policy makers need the skills (or access to the expertise) to understand, interpret and synthesise science advice. Scientists need to understand the policy process and timeframes (see section 3).

Planning how to communicate the underlying science and present the policy options for consultation can facilitate consultative processes. Early engagement on science issues can also help ensure that later consultations are focused on developing the policy framework, instead of debates over the credibility of the underpinning science (see section 4).

Adoption

Policy adoption refers to the coordination, decision-making and implementation phases of the policy process. Coordination describes the internal government process of discussing issues such as funding and administration processes prior to presentation to decision-makers. Decision-making on policy is done through government, either through Cabinet or the relevant portfolio Minister. Implementation may then include legislative change, new funding instruments, information campaigns or operational change to institutions. Program design and management are all aspects of the adoption stage.

It is important to ensure that scientific elements are clearly articulated within policy proposals for decision-makers. The coordination and decision-making phases can be seen to further test the credibility of the science as other Commonwealth agencies and Ministers may access or possess their own scientific expertise which is brought to bear to assess the policy proposal. The Chief Scientist plays an important role in providing high level independent scientific advice to government, including directly to Ministers and the Prime Minister.

Scientific and technical evidence can contribute to the design of the policy intervention or be used to test potential implementation options. Program design should incorporate effective assessment, monitoring and data collection arrangements to support evaluation of implementation and build a future evidence base.

Evaluation

Evaluation ideally occurs throughout implementation and operates to ensure that policies continue to align with the objectives of the original policy objective. Evaluation also occurs as a discrete stage at the conclusion of a policy initiative. Both ongoing evaluation and discrete reviews feed new evidence back into the policy cycle at the anticipation (identifying new issues) and formulation (information gathering and analysis) stages.

By identifying and collecting meaningful data from the outset, including relevant scientific indicators, there is a real opportunity to build a scientific evidence base for the ongoing monitoring and evaluation of the policy intervention. Establishing review panels or advisory committees that include members of the scientific community can also facilitate the systematic inclusion of science in the evaluation stage. Specific scientific impact studies can also be commissioned.

The detailed case study on the National Environmental Research Program (see Box 1, page 14), has been provided as an illustrative case study which incorporates a range of ‘best practice’ principles in policy development and program design to maximise investment in science and translation from research to policy.

Table 1: Strategies at each stage of the policy cycle

TIMEFRAME **POLICY STAGE**	**LONG-TERM** *Strategies to support preparedness*	**SHORT-TERM** *Strategies to support responsiveness and timeliness*
ANTICIPATION *Identifying issues that may require a policy response, including agenda setting.*	Identify and prioritise emerging issues and future research needs. Build robust relationships between science advisors (especially PFRAs) and policy departments to facilitate the two-way flow of information and trusted advice on emerging issues.	Utilise established relationships to undertake knowledge translation to support issues identification. Utilise established advisory mechanisms or trusted advisors to broker scientific advice on emerging issues within short timeframes.
FORMULATION *Defining the problem, gathering the information and analysing the range of options for policy consideration.*	Encourage policy makers to clearly articulate science needs and provide direction on research priorities. Utilise workforce planning, training and mobility opportunities to ensure that policy makers have the skills to research, analyse and evaluate scientific evidence. Develop and support mechanisms for sustained interaction between scientists and policy makers (e.g. 'communities of practice' and/or standing advisory bodies). Establish procurement panels to facilitate ready access to scientific expertise, including technical skills and/or science advice. Encourage the development of strategic plans for information gathering by departments, including consideration of the development of longitudinal data sets and data access and sharing across departments.	Undertake or commission knowledge translation activities which aim to synthesise and target existing science knowledge for the policy audience. Establish a taskforce or team comprising internal or seconded staff with relevant science knowledge and skills, as well as policy experience. Bring scientists and policy makers together in subject-specific workshops to foster dialogue and progress policy formulation. Utilise established relationships to source scientific advice or technical expertise, including relationships with science agencies, advisory bodies or contractors. Utilise available scientific data, including shared resources.

TIMEFRAME **POLICY STAGE**	**LONG-TERM** *Strategies to support preparedness*	**SHORT-TERM** *Strategies to support responsiveness and timeliness*
CONSULTATION *Testing the policy options through consultation (internal and external to government).*	Ensure that both policy makers and science advisors have the skills to understand and communicate the risks and implications of contested science. Ensure that policy makers have expertise to understand, interpret and synthesise science advice obtained through consultative processes. Educate scientists in the policy process, to ensure an understanding of competing policy considerations, policy needs and timeframes.	Plan how to communicate the underlying science and present the policy options for consultation. Utilise established relationships with 'trusted' advisors to mediate or broker contested or competing science advice (e.g. science agencies, the Chief Scientist or standing advisory bodies). Communicate the impact of science advice on the policy response (feedback to science community).
ADOPTION *Determining the policy intervention, decision-making and implementation.*	Educate policy makers in science communication, including presenting complex and/or contested science to decision-makers and the general public. Build robust relationships between science advisors and policy departments to facilitate ongoing dialogue on evolving science and the 'best-fit' with policy implementation.	Utilise scientific and/or technical advisory mechanisms to assist in the design of the policy intervention or test implementation options. Ensure that scientific elements are clearly articulated within policy proposals for decision-makers.
EVALUATION *Assessing the alignment, effectiveness and impact of policy adoption.*	Incorporate effective assessment, data collection and monitoring arrangements in program design. Identify and collect meaningful data from the outset, including relevant scientific indicators.	Establish or utilise review panels or advisory committees that include members from the scientific community. Commission a scientific impact study.

Box 1: National Environmental Research Program (NERP)

The National Environmental Research Program (NERP) provides approximately $20 million per annum over four years (from 2010-11 to 2014-15) for research specifically designed to inform policy and other environmental decision-makers. In December 2010, the Minister for Sustainability, Environment, Water, Population and Communities announced the establishment of five NERP research hubs, focusing on issues such as tropical ecosystems, marine biodiversity and northern Australia.

NERP builds on the Commonwealth's experience in implementing and evaluating the previous Commonwealth Environment Research Facilities program, and includes increased focus on mechanisms to ensure improved delivery to the end-users of funded research, particularly in government for evidence-based policy.

In support of this objective, the program reflects best practice principles for strengthening the links and alignment between research and the needs of policy makers:

- **involving policy makers in the framing of research questions**: NERP program guidelines and research priorities are based upon consultation across the department, with a selection panel involving both researchers and departmental representatives then working through a two-stage process to allow for the further refinement of proposals.
- **specific focus on knowledge brokering and translation**: program guidelines require that 10 per cent of the funding for each hub must be devoted to communication and knowledge brokering activities – the program also acknowledges that effective translation requires integration – across research disciplines and of new and existing knowledge.
- **facilitating access to research**: in addition to other communication efforts, all NERP-funded research outputs must be made freely and publicly available to allow their use by a broader range of decision-makers.
- **enhancing mutual understanding**: the program also supports enhanced two-way engagement through mechanisms such as the identification of departmental end-users and contact officers for each hub, short-term secondments for researchers into the department and the 'pairing' of researchers and policy staff.
- **innovation in evaluation**: the NERP monitoring and evaluation strategy requires regular reporting on the usefulness of research in policy, with a mix of quantitative and qualitative measures employed.

Common challenges of linking research and policy remain, such as differing timelines and time pressures, and particularly the reward structures within which research and policy staff work, which often do not explicitly value the types of activity outlined above. The broader 'policy for science' settings exert an influence over 'science for policy' programs such as NERP, by shaping the institutions within which people work. For programs specifically funded to support policy-relevant research, key lessons include the importance of collaboration between research and policy partners from the outset, as well as retaining some flexibility in funding through the life of the program to address issues and opportunities as they arise.

The NERP example demonstrates that through thoughtful program design, it is possible to fund activities that achieve the twin objectives of enhancing Australia's world-class environmental research capabilities while also delivering useful knowledge, tools and information to policy makers and the broader community.

Source: The Department of Sustainability, Environment, Water, Population and Communities.[11]

[11] Authored by P. Harris, HC Coombs Policy Forum, Australian National Institute of Public Policy, The Australian National University.

Community of interest

A community of interest may be a formal or informal network and may be facilitated through a central coordinated approach or an open forum. For example, the outcomes of this project and ongoing 'science in policy' work could be readily shared through the Strategic Policy Toolkit. [12] The Toolkit is an online resource that provides easy access to essential policy guidance. The system saves time while allowing policy officers in the public service to follow a robust process and learn key lessons from other policy projects.

In the United Kingdom, the Government Office for Science (see Box 2) uses collaborative informal and formal networks to create and promote guidance and frameworks, based on best practice, to support government departments to use and manage science in evidence-based policy. While this central coordinating role is less formalised in Australia, there is nonetheless a role for the science policy function within DIISRTE, which works closely with the Office of the Chief Scientist, to provide ongoing support for coordinating a community of interest around science-based policy to sustain ongoing collaboration and sharing of best practice between policy departments (see recommendation 1.2 above).

The community of interest would serve as a key mechanism for engagement across policy departments that use science, in order to facilitate ongoing sharing of best practice in the use of science in the development of evidence-based policy. Identifying key contacts across departments and establishing a presence on an online forum (e.g. the Strategic Policy Toolkit or GovDex) are the likely first steps.

Depending on the level of interest, a more comprehensive work program could be developed, to be coordinated by DIISRTE and supported by the community of interest. For example, publications for policy makers could be developed to provide guidance on obtaining scientific advice or codes of practice for scientific advisory committees, similar to work in the UK which attempts to provide a high level framework for scientific analysis and advice in policy making.[13]

Box 2: UK Government Office for Science (GO-Science)

The key role of the UK Government Office for Science (GO-Science) is to ensure that all levels of government receive the best scientific advice possible and to enable departments across government to create policies that are supported by strong evidence and robust arguments. Key activities include:

- Supporting the Government Chief Scientific Adviser and the independent Council for Science and Technology to provide high level advice to the Prime Minister and Cabinet
- Bringing together the departmental Chief Science Advisers to share good practice and address cross-cutting issues
- Publishing guidelines and codes of practice to support the work of the UK's 72 Scientific Advisory Committees across government (each of which advises on a different topic in science or engineering and is directly supported by the relevant department)
- Supporting foresight and horizon scanning projects which look into the future at major issues and futures thinking capacity.

Source: http://www.bis.gov.uk/go-science/

[12] http://strategicpolicy.govspace.gov.au/

[13] See *Guidelines on Scientific Analysis in Policy Making* at http://www.bis.gov.uk/Consultations/guidelines-on-scientific-analysis and the *Code of Practice for Scientific Advisory Committees* at http://www.bis.gov.uk/assets/goscience/docs/c/11-1382-code-of-practice-scientific-advisory-committees.pdf

2. Future science priorities

Identifying and prioritising future science and policy needs will prepare the APS to develop robust science-based policy.

The project found that there is an opportunity for the Commonwealth to consider its future research needs for policy and to communicate those needs to the science community to help prepare the evidence base for the future (see recommendation 2.1). Policy makers will need access to research and scientific expertise in specific areas in the future. Prioritising research into areas of policy relevance, in both the long and short-term, can help ensure that policy makers will have access to reliable scientific evidence within dynamic and challenging timeframes when the need arises.

Prioritising policy relevant research must be appropriately balanced with other mission-led and non-targeted research funding within the context of the national innovation system. There is also a need to prioritise and reward collaborative multi-disciplinary research with the most potential to address contemporary societal policy challenges.

Recommendation 2.1
The Commonwealth to consider its future research priorities for policy and to communicate those needs to the science community. There may be a role for the Australian Government, or the Chief Scientist for Australia, in issuing a statement of Commonwealth policy research priorities, either separately or in conjunction with other priority setting exercises.

Looking to the future

Horizon scanning, and even longer term foresighting, can be important activities to map out strategic information needs well ahead of time and anticipate areas where future science capability will be required. The Australian Public Service Commission (APSC) is currently leading 'strategic foresight exercises' which bring together key thinkers, including researchers and public servants, to consider what the issues of the future will be over the next 10 to 20 years and their implications for citizens, the government and communities.

In the UK, the Government Office for Science (refer Box 2) has a specific 'Foresight' role and capacity to "help government think systematically about the future".[14] The office operates or commissions foresight projects that examine major issues 20-80 years into the future; policy futures projects that provide futures and evidence analysis to fill specific gaps in existing understanding; and a horizon scanning centre to look at discrete issues across the entire policy spectrum.

In Australia, PMSEIC has a key role in identifying both short-term and over-the-horizon topics requiring independent scientific advice to government (see Box 3). PMSEIC itself focuses on short-term projects, with the Chief Scientist drawing on networks of expertise to provide scientific advice to government on matters requiring an immediate or short-term policy response. Portfolios are invited to raise cross-portfolio issues that may be addressed by PMSEIC, consistent with PMSEIC's whole-of-government science and technology advisory agenda.

[14] http://www.bis.gov.uk/foresight/

For over-the-horizon topics, the Chief Scientist has commissioned the Australian Council of Learned Academies (ACoLA) to undertake in-depth, interdisciplinary research and produce a report on specified long-term issues with the aim of 'securing Australia's future'. The current three-year work program to be undertaken by ACoLA was developed and endorsed by PMSEIC in collaboration with the government and in consultation with policy departments. The program tasks ACoLA to undertake rigorous iterative, multidisciplinary and collaborative research through the four Learned Academies on the following topics:

- Australia's comparative advantage
- Science, technology, engineering and mathematics – country comparisons
- Asia literacy – language and beyond
- The role of science, research and technology in lifting Australian productivity
- New technologies and their role in our security, cultural, democratic, social and economic systems
- Engineering energy: unconventional gas exploration.

Whilst each of these topics has discrete challenges to be explored, they are multifaceted, cross a range of related matters and interconnect with social, cultural, scientific, economic, technological and governance factors – all of which require consideration by government in seeking to achieve a secure future for Australia.

ACoLA's role will be to deliver a comprehensive, intersecting series of studies on these topics that incorporate best practice thinking to inform policy development. Portfolio liaison officers will engage policy departments at key points in the project to ensure the relevance of research to the policy agenda of government. ACoLA is to report key findings back to the Chief Scientist and PMSEIC, who will then consider the findings and make recommendations to government.

Box 3: The Prime Minister's Science, Engineering and Innovation Council (PMSEIC)

The Prime Minister's Science, Engineering and Innovation Council (PMSEIC) is the pre-eminent science advisory body to government. Chaired by the Prime Minister and with a membership comprising of Ministers, the Chief Scientist and a select group of experts, PMSEIC provides advice to government on scientific and technological developments.

In January 2012, the Australian Government announced a number of reforms to the council to ensure it remains relevant and able to facilitate the best connection between scientific advice and policy. Key features of the new PMSEIC include a smaller membership and more frequent meetings (three times per year), with the capacity to deal with both short-term as well as over-the-horizon topics requiring independent scientific advice to government.

Under the new model, long-term issues requiring a scientific response will be referred to the Australian Council of Learned Academies, representing the four Learned Academies, to undertake in-depth, interdisciplinary research and report to the government through the Chief Scientist.

Source: Office of the Chief Scientist

Priority setting

In the USA, the Office of Science and Technology Policy issues a biennial statement of multi-agency science and technology priorities as guidance for budget submissions from its publicly funded research agencies. Multi-agency priorities recognise that, while adequate resources need to be devoted to mission-driven research, there are "grand challenges" requiring advances in science, technology and innovation, which cannot be addressed effectively by a single agency.[15] One of the priorities within the 2012 statement is "R&D for informed policy making and management", under which agencies should give priority to R&D that: strengthens the scientific basis for decision-making; enhances the accessibility and usefulness of data and tools for decision support; or advances the delivery of specified policy goals.

In Australia, the National Research Priorities (NRPs) serve as a broad overarching framework for signalling the Australian Government's aspirations in relation to public research. The four NRPs are:

- An environmentally sustainable Australia
- Promoting and maintaining good health
- Frontier technologies for building and transforming Australian industries
- Safeguarding Australia.

Following the recommendations of the *Focusing Australia's Publicly Funded Research Review* (the 'Research Review'),[16] DIISRTE undertook consultations with the research sector and within government to refresh the NRPs. The consultations indicated that, while the NRPs form a broad and useful statement of national research endeavour, they may not be the most effective mechanism for guiding and prioritising government research investment.

The Research Review also recommended the establishment of the Australian Research Committee (ARCom), led by the Chief Scientist, to guide Australian Government research investment, including the development of the National Research Investment Plan ('the plan') (see Box 4). Consideration of the role of the NRPs in the future will be completed as part of the process to develop the plan. It is likely that the plan will also be the most appropriate mechanism for the Commonwealth to consider an approach to whole-of-government science and research priority setting in relation to the policy challenges of the future.

It should be noted that Commonwealth priority setting on research needed to inform the policy challenges of the future does already occur at the portfolio level. For example:

- Under the *National Security Science and Innovation Strategy* (NSSIS), an annual statement of priorities is issued to identify key areas where science and innovation research can contribute to support NSSIS objectives.[17]
- The Rural Research and Development Priorities aim to balance new and ongoing R&D investment needs for the primary production sector, and to ensure R&D objectives of the Australian Government are met.[18]

[15] http://www.whitehouse.gov/sites/default/files/m-12-15.pdf
[16] http://www.innovation.gov.au/Research/Pages/FocusingAustraliasPubliclyFundedResearch.aspx
[17] http://www.dpmc.gov.au/nsst/annual_statement.cfm
[18] http://www.daff.gov.au/agriculture-food/innovation/priorities

Box 4: Australian Research Committee (ARCom) – National Research Investment Plan

The Australian Research Committee (ARCom) has been established to provide integrated and strategic advice on future research investments, including in the areas of human capital, infrastructure and collaborative activities.

National Research Investment Plan

ARCom will develop a National Research Investment Plan ('the plan') for consideration by government in late 2012. The plan will support future decisions by the government in relation to the level and balance of research investment for the period from 2013-14 to 2015-16. The plan will consider, among other things:

- an overview of the location and capabilities of Australia's excellent researchers and innovators
- areas of world class collaborative research activities
- areas of demand by industry, government and other end users
- future priorities for major strategic research investments.

ARCom will review the plan every three years, or as necessary, to support future decisions by the government in relation to ongoing research investment.

Membership

ARCom is chaired by the Chief Scientist for Australia, and consists of three elements:

- a senior Commonwealth officials group
- an expert advisory group to provide cross sectoral guidance, including the CEOs of the Australian Research Council and the National Health and Medical Research Council
- a group of publicly funded research agencies and other organisations responsible for delivering science and research funded by the Australian Government, including CSIRO.

The expert advisory group and the group of publicly funded research agencies provide their advice to the senior Commonwealth officials group, which in turn provides advice to government.

Source: Department of Industry, Innovation, Science, Research and Tertiary Education

- The National Health Priority Areas (NHPAs) initiative emphasises collaborative action between Commonwealth and State and Territory government, non-government organisations, health experts, clinicians and consumers, for specific diseases and conditions. NHPAs are diseases and conditions that have been chosen for focused attention at a national level because of their significant contribution to the burden of illness and injury in the Australian community.[19]

Australian Government White Paper processes are also important priority setting exercises for identifying future policy challenges. For example, the Australia in the Asian Century White Paper will consider the likely economic and strategic changes in the region and what more can be done to position Australia for the Asian Century.[20] The paper is being developed by a whole-of-government taskforce, led by Dr Ken Henry AC, and supported by an Advisory Panel with a vast array of experience in the government, business and academic sectors. The White Paper will be released later in 2012 and will set out a strategic framework to guide Australia's navigation of the Asian Century. It will also set out a series of actions that

[19] http://www.aihw.gov.au/health-priority-areas-faq/#NHPA_strategy
[20] http://asiancentury.dpmc.gov.au /

will be taken over the next five years and further policy initiatives to be developed over the next 10 to 15 years.

There are opportunities also for the government to invest in specific programs and funding initiatives that support collaborative research to inform policy. Examples of current support include:

- NERP provides approximately $20 million per annum over four years (from 2010-11) for research specifically designed to inform policy and other environmental decision-makers (see Box 1).

- The NHMRC Partnerships for Better Health – Projects are designed to help create partnerships among decision-makers, policy makers, managers, clinicians and researchers (see Box 5).

- The HC Coombs Policy Forum receives $1.5 million per annum under the Commonwealth-ANU Strategic Relationship to partner with government in translating research into innovative policy solutions (see Box 12).

Box 5: NHMRC Partnership Projects

NHMRC Partnerships for Better Health – Projects (Partnership Projects) will help create partnerships among decision-makers, policy makers, managers, clinicians and researchers. This funding scheme provides funding and support to create new opportunities for researchers and policy makers to work together to define research questions and undertake research and also to interpret and implement the findings. Partnership Projects will answer a specific research question to influence health and well-being through changes in the delivery, organisation, funding and access to health services.

Source: http://www.nhmrc.gov.au/grants/apply-funding/partnerships-better-health/partnerships-projects

3. Human capability in science and policy

Effective science-based policy requires the development of appropriate human capability to ensure that policy makers understand science and researchers understand policy, including the limitations of both 'worlds'.

Scientific research and policy making are often described as two separate worlds, with very different cultures.[21] In order to maximise the value of engagement between researchers and policy makers there is a need for greater mutual understanding of these respective 'worlds'. Scientists need to understand the role science can and cannot play in policy and the constraints under which policy makers operate. They also need to see that their input to policy is valued and has an impact. Policy makers would benefit from a greater understanding of the research environment, not only to understand the limitations of what researchers 'can do for them', but also to improve their own capabilities to research, analyse and understand scientific evidence.

The project makes five recommendations designed to build human capability on both the supply-side and demand-side of the science-policy interface (see recommendations 3.1 to 3.5 below). The focus of this section is on opportunities to 'bridge the worlds' through training, mobility, workforce planning, recruitment and career-based incentive and reward systems. Engagement between the two worlds is also introduced as a key element in facilitating the incorporation of scientific evidence in policy. This theme is then explored further in section 4 which deals with relationships and communication in more detail.

Recommendation 3.1
APSC to take the lead in promoting and developing training, mobility and recruitment initiatives to enhance the scientific literacy of APS leaders and policy makers.

Recommendation 3.2
Departments and science agencies to promote or establish mobility programs that seek to provide policy makers with the opportunity to work in science related roles and scientists with the opportunity to work in policy related roles.

Recommendation 3.3
Science agencies to incorporate training and other development opportunities within learning and development frameworks that aim to help scientists understand policy development and the role of science in policy from the perspective of policy makers.

Recommendation 3.4
Departments to implement workforce planning and recruitment strategies that consider existing and future human science capability and skill requirements.

Recommendation 3.5
DIISRTE to explore options to strengthen the linkage between science and policy by encouraging and rewarding effective collaboration between researchers and policy makers.

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[21] Botterill. May 2012. See also Council for Science and Technology (CST), United Kingdom. October 2008. *How Academia and Government can Work Together* at http://www.bis.gov.uk/assets/cst/docs/files/whats-new/08-1556-academia-government.pdf

Bridging the worlds

Communication between the scientific research and policy making worlds can be challenging. Policy makers need to ensure they are clear about what research they require, including involving the scientific researchers in helping to define the problem and determine the most appropriate research, so that meaningful agreement can be reached on what research can be done, in what time and presented in what form. At times, policy makers need to accept that some research cannot be conducted within truncated timeframes, no matter how urgent the request.[22] At the same time, researchers need to understand the time pressures policy makers operate under and focus on delivery of the most useful output or interchange.

Researchers with experience of successful engagement with policy emphasise the importance of *informing* policy, rather than seeking to influence policy outcomes. The policy naïve scientist may tend towards a 'reductionist' view where their own perspective or discipline is assumed to provide the solution to the policy problem.[23] "The connected scientist is more aware of the role research can and cannot play in the policy process and the mechanisms available through which to inform policy".[24] Scientists who are successfully engaged in the policy process are able to make a clear distinction between their research input and the decision-making role of policy makers. Such researchers understand that robust research-based evidence is important in informing policy, even if the final policy decision does not fully reflect the input provided.

In the last two years Geoscience Australia (GA) has invited the Attorney-General's Department to jointly present real life experience to up-and-coming leaders in GA. This collaboration provides participants with an open forum to listen to and discuss how leaders in science and policy work together successfully to deliver mutual outcomes. The informal presentation draws on real scenarios and elicits discussion on how to avoid the pitfalls that are not so obvious when two agencies with different cultures come together to deliver a public policy outcome.

Commonwealth science agencies, such as PFRAs, hold unique positions as internal, trusted advisers to government and, as such, can assist to effectively 'bridge the gap' between science and policy. For example, both DSTO and ABARES (see Box 6) are scientific agencies within their respective portfolio departments. Given DSTO's role as an internal trusted scientific adviser for the Australian Defence Organisation and national security agencies, the expertise of DSTO scientists can be readily accessed by policy makers in Defence. In addition, Defence has an annual review mechanism to guide the shape of DSTO's science program to ensure DSTO expertise is available to support the highest priority Defence objectives.

In the United Kingdom, a more coordinated approach has been adopted to 'bridging the worlds', as highlighted in the 10 point action plan on how academia and government can work together, issued by the Government Office of Science in June 2009 (Box 7). The action plan aims to encourage a more coordinated, coherent and effective approach to strengthening engagement, in recognition that "a healthy engagement between academics and policy makers is essential to the provision of informed, evidence based, world-class policy making".[25]

[22] CST. October 2008.
[23] Botterill. May 2012.
[24] Botterill. May 2012.
[25] CST. October 2008. 6.

Box 6: ABARES – a model of embedded scientific advice capacity

The Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES), as a division of the Department of Agriculture Fisheries and Forestry (DAFF), is a fully embedded and dedicated agency supplying science and economic advice directly into policy. The proximity to policy allows for close and iterative work but requires a firm commitment to professional independence.

ABARES provides professionally independent, world-class research, analysis and advice for departmental policy divisions, government and private sector decision-makers on significant issues affecting Australia's agriculture, fisheries and forestry industries. Stakeholders rely on ABARES to produce economic and scientific research, commodity forecasts, statistics and other analysis based solely on sound and broadly accepted economic and scientific concepts and principles and the latest available information and data.

ABARES maintains its professional independence through:

- recruiting, developing and maintaining staff with expertise in relevant disciplines
- undertaking rigorous research and review processes
- the final point of clearance of publications being the Executive Director of ABARES
- pursuing an objective of publishing all research outputs and recognising authorship of individual staff
- maintaining a public presence in supporting, clarifying and communicating the content of outputs
- undertaking research for a range of public and private sector organisations
- collaborating with researchers from other domestic and international research organisations.

In undertaking policy analysis, ABARES examines the full range of alternative options potentially available to policy makers and, at times, may enter into public discussion on its research findings and on the consequences of alternative policies. ABARES also has the ability to contribute directly to the development of public policy. This role is important for the government in making informed decisions based on the best available information and analysis. This role places certain responsibilities on ABARES, at times, to operate within the confidential realm of policy making.

Source: Department of Agriculture, Fisheries and Forestry.

Box 7: The United Kingdom's 10 point action plan

Build relationships and communication

1. Promote placements for civil servants to academia

2. Promote National Academy pairing schemes between scientists and civil servants

3. Work with Research Councils to support placements from academia to government

Build capacity to ensure a more productive engagement

4. Include awareness of the research process as part of Civil Service training

5. Support Heads of Analysis, Scientific Advisory Councils, Departmental Chief Scientific Advisors in their role as promoters of engagement between academia and government

6. Revise Guidelines on Scientific Analysis in Policy Making

7. Support universities as they seek to improve their capabilities and structures for engaging with government

Rate, value and reward the engagement

8. Raise the profile of skills that policy makers acquire through engaging with academia

9. Include engagement with external research in the Science and Engineering Assurance exercise

10. Promote the recognition of policy engagement as a valued part of academic careers

Source: http://www.bis.gov.uk/go-science/science-in-government/strengthen-engagement/ten-points

Best of both worlds

A key finding of this project has been the importance of 'boundary players' in operating at the intersection point, and mediating between the science and policy worlds. Research suggests that boundary players (individuals or institutions) can be very effective at bridging the gap between science and policy.[26] Individual boundary players are generally people who have operated at some stage through their careers as both researchers and policy makers, making them relatively comfortable working in either environment.

There is considerable scope for providing mechanisms to support these types of diverse career experiences, including secondments and internships within and across the government and research sectors. For example, APSC coordinates and supports APS-wide training and career development. It has developed a series of principles for advancing employee professional development through mobility initiatives.[27] There would be value in broadly promoting these principles, or even adapting them to specifically address advancing the human scientific capacity of the APS (see recommendation 3.1). The APSC advocates supporting the planned movement of employees within and across organisations to enhance capability development, as part of workforce planning and professional development strategies.

Similarly, while not targeted specifically at interchanges between science researchers and the APS, research workforce mobility, including inter-sectoral mobility is also one of the priority areas of the Australian Government's Research Workforce Strategy.[28]

There are a number of best practice examples, both domestically and internationally, of secondment and interchange programs to support professional development to advance scientific and/or policy understanding.

- DIISRTE's Portfolio Interchange Program encourages departmental employees to undertake six month placements in any of its scientific agencies or divisions (e.g. CSIRO, AAO, AIMS) and vice versa.

- The Department of Treasury offers staff the opportunity to undertake 36 month secondments to the Australian National University to undertake research projects of direct relevance to the Treasury, as part of an ongoing memorandum of understanding between the department and the university.

- The American Association for the Advancement of Science manages and administers Science & Technology Policy Fellowships in five program areas to provide the opportunity for accomplished scientists and engineers to participate in and contribute to

[26] Botterill. May 2012.
[27] APSC *Employee mobility: principles for advancing professional development*. http://www.apsc.gov.au/learn/employee-mobility-for-professional-development/employee-mobility-principles-for-advancing-professional-development
[28] http://www.innovation.gov.au/Research/ResearchWorkforceIssues/Documents/ResearchSkillsforanInnovativeFuture.pdf

the federal policy making process while learning firsthand about the intersection of science and policy.[29]

- DSTO offers its scientists opportunities for two-year development positions in its corporate headquarters in Canberra. These development positions are usually in policy making roles.

Departments and science agencies can look to these examples to promote or establish mobility programs that seek to provide policy makers with the opportunity to work in science related roles and scientists with the opportunity to work in policy related roles (recommendation 3.2).

Even short-term secondments can have benefits in terms of scientific input to policy. Importantly, these secondments can develop relationships and educate both policy makers and scientists in each other's roles. For example, staff from GA undertook short secondments to AusAID to assist in the development of the Disaster Risk Reduction policy. These secondments provided crucial scientific input to the policy process, and additionally increased GA's understanding of the culture and requirements of the policy environment.

Scientific literacy in the APS

An appreciation of the nature of scientific evidence, including the nature of scientific discovery, is critical to ensuring that policy makers are receptive to and have the capability to undertake evidence-based policy.

An understanding of the development framework around scientific research can help policy makers identify points where scientific input may best feed into policy development. Policy makers need to understand that the ongoing generation of hypotheses and testing of ideas through experimentation, data collection, interpretation, analysis and feedback are central to the scientific process. Science is a process of doing, more than an end state of knowing.

Policy makers additionally need to understand that identifying issues may involve agencies commissioning research, while consideration of implementation options may require modelling work to map possible outcomes.

Data is a key element of scientific evidence and pivotal for developing policy responses. Policy makers need to know how to find and understand scientific data (research methods). They need to have access to the skills to analyse and interpret the data (e.g. statistics and modelling). However data is only as good as our ability to collect, access and understand it. There is evidence of an emerging shortage of qualified statisticians and mathematicians in Australia who can act as brokers for this type of work either within the public service or in the science sector.[30] The Chief Scientist is investigating possible means to assist with this shortfall in technical experts across the community.[31]

Policy makers need to be in a position to understand aspects of research design, error and 'fitness for use', that is whether the data has been developed for a different or similar problem, including any qualifiers on the accuracy or completeness of data. Not only does this ensure data is used effectively, it also provides policy makers with appropriate confidence in the scientific evidence being utilised. A greater degree of transparency in the

[29] http://fellowships.aaas.org/
[30] http://www.innovation.gov.au/Science/ResearchInfrastructure/Pages/default.aspx
[31] Office of the Chief Scientist. *Health of Australian Science*. May 2012. http://www.chiefscientist.gov.au/wp-content/uploads/Report-for-web.pdf

process for collecting the data can assist in indicating its limitation and gaining buy-in from stakeholders. For example, the case study detailed in Box 8, demonstrates the importance of data literacy to ensuring that data is appropriately used and translated in the policy context.

Box 8: Statistical indicators to evaluate policy outcomes

Under the Inter-Governmental Agreement on Federal Financial Relations (IGA, 2008) there has been a welcome and increased focus on using statistical indicators to evaluate progress in policy outcomes and facilitate public accountability. The application of quantitative measures to monitor outcomes for key Council of Australian Governments (COAG) policy initiatives heralded a shift from the auditing of inputs to the measurement of outcomes. Grounding the policies in statistics aimed to give a level of scientific rigor to policy setting and evaluation. The initial development of these indicators and their application to the measurement of outcomes, however, did not always fully consider the fitness for purpose of the underlying evidence base.

Under the IGA, the Commonwealth and State/Territory governments undertook to drive reform in healthcare, disability, education, housing, workforce skills and Indigenous affairs through a raft of national agreements, some of which had specified outcome targets and timelines. In some cases, these targets were associated with reward payments by the Commonwealth to the States and Territories. For example the National Partnership Agreement on Youth Attainment and Transitions set targets to boost the level of Year 12 or equivalent attainment across Australia. The baseline measure and annual progress was to be monitored using results from the Australian Bureau of Statistics Survey of Education and Work.

The Year 12 attainment target was specified as the proportion of young people aged 20–24 years who had attained Year 12 or at least a Certificate II. At the national level, educational attainment at Year 12 or equivalent has generally increased steadily over the past 10 years in accordance with policy objectives. The survey results, however, have not thrown clear light on annual progress at the State and Territory level. There are two reasons for this. First, this indicator is of limited value as a measure of State/Territory education system performance, since it overlooks the impact of interstate and international migration after school. Second, and importantly, the chosen survey was unable to deliver useful information because the sample size for the narrow population of interest (20-24 year olds) was far too small to yield reliable estimates at the State/Territory level.

These problems have led to a much sharper focus on measurement quality together with robust discussions about alternative and more appropriate data sources, such as the Census of Population and Housing or administrative data held by State/Territory education departments. A great deal has been learned in the first three years of COAG national reporting and the lessons learned are contributing to better use of statistics. The process has offered opportunities for staff in policy departments and generalists in the Australian Bureau of Statistics alike to lift their level of statistical literacy and increase their understanding of the interface between evidence and policy.

Source: Australian Bureau of Statistics (ABS)

It is important, therefore, that policy makers have the scientific literacy required to understand, utilise and evaluate scientific inputs to policy. There is a key role for the APSC to develop a scientifically literate APS, as part of its mandate to ensure that the APS has the leadership and core capabilities required to meet current and future policy challenges (see recommendation 3.1).[32]

There is value also in recruiting individuals with a background in science to work in policy teams in government. Science educated policy makers possess “critical thinking skills, the

[32] http://www.apsc.gov.au/learn/strategic-centre-for-leadership,-learning-and-development

ability to analyse, and commitment to processes based on evidence".[33] Furthermore, it is common for science educated individuals to utilise both science knowledge and science-associated skills in their work, whether they work as 'scientists' or in other work environments, including business, government and education.[34] Research degrees in any discipline, can also assist policy makers to understand the research process and its potential to contribute to policy, as well as strengthen skills in analysis and the use of evidence.

Ongoing scientific education can also be achieved through short professional courses, either to develop technical science skills or subject-specific courses to inform policy makers of the state of the discipline and latest research findings. The ABS, for example, provides both training and resources to increase statistical literacy and support the use of statistics for informed decision-making.[35]

The Australian National University's Institute of Public Policy (see Box 9), under the Crawford School banner, brings together a number of new and existing programs designed to advance the University's world-class contribution to public policy research, teaching and outreach and to strengthen the engagement between policy makers and policy-relevant researchers. The Institute, announced on 12 April 2012, aims to bring to fruition plans initiated in 2010 to build a strategic relationship between the Commonwealth and the ANU focused on enhancing the public policy capability of the APS. Dr Ken Henry has been appointed as the Executive Chair to lead the Institute. An Advisory Board also ensures close collaboration between ANU and the APS.

Box 9: The Australian National University's Institute of Public Policy

The Institute of Public Policy builds on the strategic relationship between the Australian Government and the Australian National University (ANU), which is designed to strengthen the already substantial engagement between the public policy community and relevant expertise across ANU, also drawing on the university's links into the broader research community and public.

Among the aims of the Institute are to:

- improve the connection between the public sector and the best in public policy research from across Australia and world
- foster innovative relationships between the public sector and relevant academic institutions in an open and facilitative way
- build an enhanced evidence base on which policy practitioners can draw to develop future public policy
- develop the capability of Australian public servants so that they can identify and adopt best practice thinking and action and strive for the highest standards of professional achievement.

The Institute coordinates relevant activities across the ANU, including executive education and graduate coursework specifically targeted at the needs of the APS; the HC Coombs Policy Forum – the Institute's public policy "think tank"; the Sir Roland Wilson Foundation, which provides PhD scholarships for APS staff to conduct policy-relevant research; and the newly created Public Policy Fellows Program, which recognises and champions substantial contributions to public policy, including expertise within and outside of the ANU.

Source: The Australian National University

[33] Rice, J. in Harris, K. *Background in Science: what science means for Australian society*. A study commissioned by the Australian Council of Deans of Science. April 2012. V.
[34] Harris, K. April 2012.
[35] ABS. *A guide to using statistics in evidence-based policy*. 2010. http://www.abs.gov.au/ausstats/abs@.nsf/mf/1500.0

The project therefore recommends that consideration be given to promoting and developing appropriate training and mobility opportunities for both policy makers and scientists (see recommendations 3.1 to 3.3). Such initiatives have the potential to build science literacy and understanding in policy makers and policy understanding in scientists in order to bridge the two worlds. The project also recommends that departments consider and implement workforce planning (see recommendation 3.4), which may include recruiting staff with a science education or providing the opportunities for staff to undertake graduate education opportunities.

Developing communities of practice that involve scientists and policy makers with expertise around a set of issues can also assist in improving the scientific literacy of policy makers, as well as the policy understanding of scientists, thus enhancing the use of scientific evidence to underpin policy.[36] This theme is explored in more detail in section 4.

Science capability

Workforce capability refers to what the workforce can do; the skills and knowledge of the workforce. It can be used to describe existing capability, latent capability (that is, skills and knowledge that exists in the workforce but is not currently being used) and future capability (that is predicting what skills may be required and any potential gaps).[37] Science skills shortages within the APS can affect the capacity of the public sector to do, interpret, translate, understand and engage with science. Consistent with the Blueprint's recommendation that departments undertake deliberate planning,[38] this project recommends that departments incorporate consideration of existing, latent and future science capability in workforce planning and recruitment strategies (see recommendation 3.4).

As noted above, there is value in recruiting individuals with a science background and education to work within policy departments. Consideration may therefore be given to graduate recruitment strategies that target science qualified graduates. It may also be valuable for departments individually, or the APSC, to undertake a census of the science qualifications within the APS workforce, as a guide to the existing and latent capability of the APS to know, understand, use and engage with science.

In some areas, consideration may also be given to creating or identifying science positions, to be filled by appropriately qualified or experienced scientists, to undertake work to support policy development. For example, the Department of Regional Australia, Local Government, Arts and Sport has engaged an out-posted ABS officer who acts as the interface between data which is fit-for-purpose in policy development, as well as gaining a greater appreciation of the policy environment. Similar arrangements exist between the ABS and other departments. These sorts of human resource sharing arrangements between agencies are mutually beneficial, adding capability, expanding knowledge and bridging gaps.

Departments with embedded science agencies are also able to effectively utilise in-house capability to support policy development, such as the working party established at DSTO to support the development of Defence Space Science and Technology Policy (Box 10.)

[36] Forest, P. and Hickey, G. *Summary Report on the Strengthening the Environmental Science & Public Policy Nexus Workshop Series 2010.* 2011. 9.
[37] APSC. *Workforce planning guide. http://www.apsc.gov.au/publications-and-media/current-publications/workforce-planning-guide*
[38] http://www.dpmc.gov.au/publications/aga_reform/aga_reform_blueprint/index.cfm

Human resource data systems that identify and track existing scientific knowledge and skills can also assist the APS to make most effective use of its workforce, including identify latent capability. These systems facilitate effective use of human capital and staff deployments within the APS, as well as assisting in identifying gaps to inform workforce planning.

The APSC's *APS Workforce Planning Guide* presents a common approach to workforce planning and builds on existing information and good practice across the APS.[39] The guide includes strategic planning tools and templates that can be integrated with business planning cycles. The APSC's workforce planning framework introduces a Job Family 'occupational group' model to enable APS agencies to map, profile and clearly understand the skill areas in their workforce.

Box 10: Working Group of Defence Space S&T Policy

In 2011, DSTO began developing a Defence Space Science and Technology (S&T) Policy to align with Defence's and Australian Government's priorities for the access and use of space. The aim of the policy was to maintain and enhance Australia's military and national security advantage provided by space, through establishing innovative, coordinated, world-class space research programs in identified priority research areas.

The development of the Defence Space S&T Policy relied on specialist technical input which the DSTO policy area did not have. As such, the policy area set up a dedicated in-house technical working group, comprising DSTO scientists with space S&T knowledge and expertise, to provide scientific advice through the policy development process. The working group was established by contacting an area within DSTO with strong interest in space and using their informal networks to identify additional participants from other relevant areas.

This working group provided the policy makers with ready access to scientific input and advice throughout the policy development process. Members were asked to contribute a small amount of their time to providing scientific and technical input into the policy as well as influencing other aspects of the policy, such as the governance and financial aspects. The working group successfully assisted in brainstorming policy issues and advising on the direction of the policy based on their scientific understanding. Draft versions of the policy were also circulated to the working group for comment and input.

Source: Defence Science and Technology Organisation (DSTO)

Rewarding engagement

Another recurring theme throughout the project has been the lack of incentive structures to support engagement between researchers and policy makers. Effective networks of scientists and policy makers have the potential to be undermined by competing priorities and differing reward systems of the policy making and scientific research worlds.

Part of this relates to the quality of the engagement experience itself, including appropriate feedback. Not only do policy makers need to be clearer about what they expect from scientific experts, they also need to ensure that they provide feedback on how scientific inputs were used to inform policy development and the final policy response. Failure to provide such feedback can leave the contributors feeling ignored or forgotten and means that lessons are not learned for the next engagement.[40] This is especially true when researchers have not been engaged throughout the policy development process and have

[39] http://www.apsc.gov.au/publications-and-media/current-publications/workforce-planning-guide
[40] CST. October 2008. 8.

not been exposed to the multiple and contested inputs with which the policy maker has had to work.

There is additionally an apparent mismatch between the output focus of universities and the needs of the policy process.[41] For researchers, effective policy engagement is a long-term investment that involves building relationships and networks with policy makers at the appropriate level in the APS. Such activities and the time and effort devoted to them are rarely rewarded by universities in performance assessments. Indeed the focus on peer-reviewed publications as a key performance measure has been criticised as encouraging a situation where "the majority of researchers are talking to each other in journals that public servants 'never read' rather than engaging in public policy debate in a timely manner".[42] Greater emphasis needs to be placed on the importance of scientific work in the policy context and ensuring scientists are rewarded for their contribution to the debate.

A further disincentive is provided by the strong disciplinary silos that continue to dominate academic research for a variety of reasons.[43] Yet today's policy problems are complex, requiring solutions that transcend disciplinary boundaries. For policy makers there is a real need for expert advice that is derived from interdisciplinary research, or that can translate and synthesise research from multiple disciplinary sources.

Depending on how scientists choose to engage with policy development, they can have differing levels of impact on policy development. For example, scientists from universities and other research institutions generally retain control over their research, but may have less impact on policy decisions. In contrast, scientists from PFRAs often have more impact due to, for example, having access to information leading to a decision by Cabinet, but as a trade-off to this they generally relinquish some control of the direction of their research activity. Integration of scientists within the policy making environment not only facilitates a greater understanding of how their work can impact upon policy development, it also reinforces continued engagement and reward.

Within the Industry, Innovation, Science, Research and Tertiary Education portfolio there is a range of policy work underway with the potential to investigate and incorporate incentives for enhanced collaboration between researchers and policy makers, including work on research impact, research training and ARC's ERA initiative. It is therefore recommended that DIISRTE take the lead in progressing this work (see recommendation 3.5), noting that there is also scope for science agencies to consider reward structures within their own organisations for policy engagement activities.

[41] Botterill. May 2012.
[42] Botterill. May 2012.
[43] Botterill. May 2012.

4. Relationships and communication

Effective and appropriate science-policy relationships and communication will facilitate the uptake of scientific evidence and advice in policy development.

Sustained communication and networking between scientists and policy makers is important to ensuring that science more routinely and significantly informs policy development. Effective science-policy relationships can facilitate opportunities for timely advice which is appropriately framed for policy makers.

Policy makers need to clearly communicate what research is needed, in what format and within what timeframe. Often policy needs are research synthesis, translation and knowledge brokering, rather than cutting-edge scientific results.

This section provides best practice examples of effective interactions, including 'communities of practice', relationships based on knowledge translation and the role of knowledge brokering in managing science and managing policy uncertainty (see recommendation 4.1).

In addition, there are a range of formal and informal scientific advisory mechanisms which can be utilised to support policy development, including consultation mechanisms. This section pays particular attention to key lessons in consultation and public communication. A range of other science advisory mechanisms, not otherwise substantially covered in the text, are also detailed in Appendix 5.

While there is no obvious one-size-fits-all approach to science advisory mechanisms, there is an opportunity for departments to benchmark their own practice and consider options to better facilitate the uptake and acceptance of robust evidence-based science in policy (see recommendation 4.2).

Recommendation 4.1
Portfolios to promote or establish science liaison functions to facilitate and coordinate communities of practice, knowledge translation and knowledge brokering in domain areas.

Recommendation 4.2
Departments to review and enhance existing science advisory mechanisms to facilitate the uptake and acceptance of robust evidence-based science in policy initiatives.

Science-policy relationships

Effective use of scientific evidence during the policy development process can be built upon informal or formal relationships, through networks or through contracted advice. Communities of practice can be innovative and effective mechanisms for connecting and sustaining networks between scientists and policy makers.

Robust relationships and networks can be a key factor for scientific input being considered and used by policy makers. Dripps and Bluml note, "that there is a degree of serendipity about some policy-science interaction. This suggests that networks have value, even without

specific intent".[44] Informal relationships and networks can assist policy makers to know where to go or where to start for advice. For example, the Western Australian (WA) Government was aware of Professor John Dodson's expertise in environmental research from his time working as a researcher at the University of Western Australia, so contacted him for advice on sourcing expertise on groundwater dating and water quality. Professor Dodson, now Head of the Institute for Environmental Research at the Australian Nuclear Science and Technology Organisation (ANSTO), was able to connect the WA Government with appropriate researchers at ANSTO who were able to undertake the research required.

Informal relationships and networks generally develop over time and in support of common objectives. Informal relationships can become formalised through government funding programs designed to support collaboration. For example, the Department of Sustainability, Environment, Population and Communities (DSEWPaC) has been forging a strong, collaborative relationship with Australia's marine science community over the last decade in relation to its marine planning agenda. This relationship has been formalised and funded through the Marine Biodiversity Hub of NERP (see Box 1), which represents a significant investment of public funds for the purposes of consolidating marine biophysical and ecological data, knowledge and the development of tools to support decision-making.

Communities of practice are groups of people who are linked by a shared interest in a domain of practice and interact regularly to advance that practice.[45] Generally communities of practice involve regular interaction through events and other engagement opportunities (e.g. online forums) with the objective of practicians learning with and from each other. Communities of practice that involve scientists and policy makers therefore provide an opportunity for strengthening interactions, developing mutual understandings between the 'two worlds' (see section 3) and facilitating knowledge creation and sharing.

A community of practice may also facilitate access to the latest scientific evidence. For example, policy makers within the Department of Health and Ageing can access evidence derived from systematic reviews of health care interventions and best practice information on the delivery of effective health services through the Policy Liaison Initiative (see Box 11).

Workshops that bring together scientists and policy and program managers around a particular area of science can also be effective mechanisms to strengthen science-policy linkages.[46] Indeed regular workshops can be a key element in ongoing communities of practice or stand-alone events convened to advance a particular policy problem. Workshops are beneficial in that they provide an opportunity to highlight recent science, identify research needs and foster dialogue between scientists and policy makers.

In Canada, a series of innovative workshops linking water science to policy helped identify 'best practices' for science-policy workshops, including:

- choosing nationally and internationally recognised science experts with strong public speaking skills to raise the prestige and credibility of the event
- inviting researchers from a range of relevant areas of expertise to encourage interdisciplinary insights

[44] Dripps, K. J. and Bluml, M. Landscape Analysis and Visualisation. *Improving the use of science in evidence-based policy: Some Victorian experiences in natural resource management.* Chapter 3. 29-48.
[45] Wenger, E. *Communities of practice –a brief introduction.* 2006. http://www.ewenger.com/theory/communities_of_practice_intro.htm
[46] Environment Canada. *Effectively Bridging the gap: The Case for Science-Policy Workshops* (Strengthening Science Policy Links: Study Series No. 3). 2010. http://www.ec.gc.ca/scitech/default.asp?lang=En&n=4ABA4A0C-1

- having speakers focus their presentations on the synthesis of current knowledge, key research gaps and policy implications in their areas of expertise
- providing a mix of policy and program initiatives with research information to draw in both audience groups and balance the discussion
- inviting attendees from all levels of government, including individuals with a role in developing and influencing policy, regulations and programs
- inviting key professional and industry representatives
- making workshops invitation-only, to manage participant numbers and ensure opportunity for engaging discussion
- having workshop moderators guide session discussions to focus on broader science-policy issues, rather than scientific details
- synthesising workshop results, including both research and policy/program needs and disseminating to a broad audience (e.g. online).[47]

Box 11: Health Policy Liaison Initiative: Evidence-based Policy Network

The Policy Liaison Initiative (PLI) is a joint initiative between the Australasian Cochrane Centre and the Department of Health and Ageing (DoHA) to encourage and support evidence-informed policy making underpinned by Cochrane Collaboration Reviews. The Cochrane Collaboration is an international organisation that aims to help people make well-informed decisions about health care by preparing, maintaining and promoting systematic reviews of health care interventions.

Under the PLI, staff from the DoHA can join the Evidence-based Policy Network (EBPN). The network is designed to support health care policy makers within DoHA make best use of evidence in their work.

Members of the EBPN can receive:

- regular email bulletins on new and updated reviews in *The Cochrane Library* and other EBP resources
- summaries of Cochrane systematic reviews of health care interventions relevant to National Health Priority Areas
- assistance facilitating discussion between the Department and The Cochrane Collaboration about policy relevant systematic reviews
- invitations to seminars and workshops on evidence-based practice and policy
- assistance with using *The Cochrane Library*
- access to the EBPN website
- access to the resources page - an archive of websites, journal articles and other resources that have been featured in the EBPN bulletin.

Access to the EBPN website provides a gateway to information on Cochrane activity in National Health Priority Areas; improving professional practice and the delivery of effective health services; and how best to communicate with people about their health and health care.

Source: Department of Health and Ageing – See also www.cochrane.org.au/ebpnetwork

[47] Environment Canada. 2010.

Knowledge translation

There is a need for policy makers to clearly articulate their research needs and for science knowledge to be customised and targeted for the policy audience, in order to improve its uptake in policy development. Knowledge translation is an activity where science information is packaged to suit the requirements of the policy user, including format and timeframe for delivery. It generally takes the form of a comprehensive review and synthesis of the current state of scientific knowledge on a particular topic, which may then be subject to broader consultation before providing the results to policy makers. Results are provided in a format that is accessible to the policy maker and may be used to inform decision-making.

The NHMRC develops evidence-based guidelines, which translate the existing body of knowledge in a particular area into rules, principles or recommendations for the consideration of decision-makers.[48] NHMRC guidelines provide information for achieving best practice in clinical practice, population health or ethics. They are developed by teams of specialists, including high level scientific experts, following a rigorous evidence-based approach, which includes literature review, public consultation and independent review phases. The guidelines are designed as advice, but may be turned into policy instruments by government (e.g. in legislation) or non-government organisations (e.g. professional codes of conduct).

The HC Coombs Policy Forum (see Box 12) undertakes collaborative translational research projects that involve literature reviews, workshops and the publication of synthesis reports. For example, in 2011 the Forum commissioned and completed a translational research project on Natural Resource Management (NRM) and regional policy and planning. This involved bringing together a steering group comprising representatives from the two departments that requested the work (DAFF and DSEWPaC), as well as from other relevant departments and the ANU Fenner School for Environment and Society. A literature review provided a baseline of existing research and knowledge, which informed a discussion paper and a workshop that brought policy makers together with a range of researchers and representatives from diverse NRM and regional groups. This project successfully informed the government's evaluation of the Caring for Our Country initiative,[49] as well as stimulating broader debate with stakeholders about key future issues in NRM and regional policy.

The Forum's newly established 'Science, Technology and Public Policy' research program provides another mechanism for strengthening ongoing collaboration between researchers and policy makers.

The Office of the Chief Scientist (OCS) performs knowledge translation through several initiatives. For example, the OCS Occasional Paper Series is a series of short publications that take relevant science from the research sector and translate it for a general audience. They bring to the public's attention scientific issues of importance to Australian society and conclude by discussing policy implications. The OCS also makes submissions to parliamentary inquiries that involve knowledge translation.

Ministers and officials from policy departments also access the knowledge translation capability of the OCS. For example, the Attorney-General's Department recently sought advice on methods for determining skeletal maturity of humans and the associated accuracy in translation to chronological age. In order to provide sufficient breadth of capability in

[48] Guidelines are produced in accordance with the *National Health and Medical Research Council Act 1992*.
[49] http://www.nrm.gov.au/

knowledge translation the OCS supplements in-house science expertise with a team of eminent advisory fellows, who also provide access to extensive knowledge networks.

Box 12: HC Coombs Policy Forum

The HC Coombs Policy Forum is the policy 'think tank' within the ANU's Institute of Public Policy, which seeks to integrate, translate and communicate policy relevant knowledge. The Forum draws on the extensive expertise at ANU, and more broadly, to better meet the needs of the APS.

The Forum employs a range of mechanisms to strengthen constructive relationships between the research community and government, translating a wide variety of relevant research in practical ways to contribute to the crafting of innovative policy solutions. The Forum supports learning from the past alongside anticipating the future, to assist in dealing rigorously and creatively with the big issues facing the nation.

Examples of the Forum's activities in 2011:

- **public engagement**: lectures and seminars on priority policy issues as well as an innovative new co-production partnership with ABC24, resulting in the new "Future Forum" series
- **collaborative workshops**: bringing together researchers and policy makers (specifically including early and mid-career staff) to discuss policy challenges and shape future collaboration
- **translational research projects**: longer-term, collaborative activities that involve literature reviews, workshops and the publication of synthesis reports
- **commissioned reports**: informed by government needs, including the Visioning Australia's Future horizon-scanning series on long-term challenges for the nation
- **international visiting fellows**: bringing in leading international researchers in line with Australian Government priorities and needs.

Source: The Australian National University

Knowledge brokering

Policy makers often need advice from science 'brokers' who are able to consider the range of policy options available and assess them in terms of scientific evidence, without actively seeking to influence decision-making in a particular direction.[50]

An 'honest broker' is distinguished from: a 'pure scientist' who provides objective scientific evidence with no regard for how it may be utilised by the policy maker; a 'science arbiter' who only addresses policy issues which can be resolved through scientific advice; or an 'issues advocate' who actively seeks to bring a particular point of view to the decision-making process.[51]

Knowledge brokering has also been described as an activity where intermediaries (knowledge brokers) or intermediary organisations link the producers and users of knowledge to disseminate and facilitate use of a range of scientific inputs.[52] The role of knowledge broker is often best occupied by an organisation or advisory body, rather than an individual.

[50] Pielke, R. *The Honest Broker: Making sense of science in policy and politics*. Cambridge University Press. 2007.
[51] This typology is taken from Pielke, 2007. Pielke advocates that any one of these roles can be appropriate and individual scientists should consider making their own judgments about how they would like to position themselves in relation to policy and politics.
[52] Environment Canada. 2010.

For example, science agencies can be commissioned to assess scientific evidence against a range of policy options as input to government decision-makers. For example, in the Northern Australian Land and Water Science Review (see Box 13) CSIRO was commissioned to assess a range of scientific inputs from diverse stakeholders and thereby broker advice to government.

Box 13: Northern Australian Land and Water Science Review

The Commonwealth Scientific and Industrial Research Organisation (CSIRO) was able to successfully broker policy options in the Northern Australian Land and Water Science review in 2009, due to clarity of roles and engagement between the scientists, sponsoring Minister, the Department of Sustainability, Environment, Water, Population and Communities and the Northern Australia Land and Water Taskforce.

The review was commissioned by the Australian Government, via the Office of Northern Australia. The review examined a range of options for use of land and water in Northern Australian and the likely consequences of those uses for communities, businesses and the environment. The role of the review detailed the key limitations and enablers required for future development in the north, including environmental, social, economic and governance considerations. The review did not provide sustainable development 'solutions' for Northern Australia. The role of the review was to provide data and insights so that others might apply their values to the problems and opportunities of sustainability.

CSIRO's expertise was sought to assess and quantify the capacity of the north's land and water assets as the fundamental underpinning for sustainable development. The review was managed by CSIRO and drew on the contributions of over 80 technical specialists, community members and industry representatives from many institutions. Importantly, the review did not seek to provide an 'institutional' position on any topic.

The engagement between the science and policy environments was conducted to a high degree of mutual satisfaction. It was indicated that the foundation for this success was facilitated by the clarity of the terms of reference and a mutual understanding of the product required.

Source: CSIRO

Science advisory committees, or advisory bodies with a broad range of members from the research sector, are generally adept at the role of 'brokering' a range of options and science inputs for the consideration of decision-makers. For controversial issues, external advisory committees can assist in lending credibility and integrity to the scientific evidence base.

When developing a new policy response, consideration can be given to establishing two separate advisory mechanisms to delineate the brokerage role in policy formulation from decision-making and policy adoption. In this case a science agency could be tasked with assessing the scientific evidence against a range of policy options for presentation to the decision-maker. Once the policy response is decided, a taskforce, with scientific or technical representation, can be established to design the policy implementation.

There are opportunities for departments to develop new and promote existing models to broker scientific advice, such as standing or temporary committees and communities of practice, and to share these ideas and lessons learnt through the best practice network (i.e. the 'community of interest' in recommendation 1.2).

An example of an innovative and broadly collaborative new approach to policy development, underpinned by design thinking methodology, is the pilot Centre for Excellence in Public

Sector Design (see Box 14). This initiative may offer new mechanisms or approaches for incorporating science in developing innovative solutions to policy problems.

Box 14: Centre for Excellence in Public Sector Design

The Centre for Excellence in Public Sector Design (the Centre) will assist the APS to meet the challenges of delivering innovative, practical solutions to today's complex problems and to explore new methods in solution formulation, development and delivery. The Centre will inspire creativity, innovation and a more citizen-centric approach through consultation, collaboration and co-design.

The pilot Centre will build innovation capability in the APS and provide for better outcomes through applied problem solving, including at the interface between the APS, other jurisdictions and providers, and the users of services.

Source: http://innovation.govspace.gov.au/

Science-policy liaison

In order to facilitate opportunities for effective science-policy relationships that link the producers of science knowledge (including individual scientists, research providers and science agencies) with policy and program users, the project recommends that portfolios give consideration to the development, establishment or promotion of science liaison functions (see recommendation 4.1). The key roles of this function would be to:

- facilitate opportunities for access to timely scientific advice, including knowledge translation services
- foster 'communities of practice' around domain areas and encouraging regular engagement between researchers and policy makers
- encourage science providers to adopt the role of 'honest broker' when providing scientific advice to policy makers.

It is likely that this function could rest within existing policy areas where officers have sufficient familiarity with both science and policy, existing networks or ability to facilitate their establishment and skills in both science and policy communication. Science agencies are also encouraged to promote their existing government liaison areas, internally and externally, and to link these with science liaison areas in policy departments.

Science as broker

Robust scientific evidence can assist to define the policy question being asked and help to balance the diverse consideration of other perspectives (including social, economic and environmental), which is an essential part of the policy development process.

Scientific evidence is but one factor to be considered in the development of policy; policy makers must manage the balance of this and economic and social factors. There is a myth that the provision of scientific advice will serendipitously lead to the resolution of the policy problem. Policy is derived through consideration of a number of inputs and knowledge brokering can help policy makers manage these diverse inputs.[53] Furthermore, "it is not evidence itself that makes good policy – rather, it provides knowledge, potential options and

[53] Harris, P. and Meyer, R. 2011.*Science Policy: Beyond Budgets and Breakthroughs*. HC Coombs Policy Forum, ANU. http://crawford.anu.edu.au/public_policy_community/content/doc/Science%20Policy%20-%20Discussion%20paper%20-%20FINAL.pdf

solutions and a key foundational basis from which other factors can be adjudicated on by Ministers and their advisor".[54]

In the Northern Australia Land and Water Science Review example above (Box 13), CSIRO acted as a knowledge broker between science and other inputs from community and industry. Similarly, DSEWPaC's experience in the development of marine reserve networks, demonstrates how brokering scientific inputs, in this case with the aid of technological tools, can help to balance potentially competing concerns of biodiversity and conservation versus social and economic impacts on marine users and coastal communities (see Box 15). There is an opportunity therefore for science to act as more than a singular contribution to policy development, and instead assist in the management of differing inputs. Rather than providing an absolute solution "it can operate to define the boundaries of uncertainty within complex systems".[55]

Box 15: Marine bioregional plans and regional marine reserves networks

Together, marine bioregional plans and the regional networks of marine reserves considerably strengthen the Australian Government's capability to support the conservation and ecologically sustainable use of the marine environment. Inputs from science underpin both the content of marine bioregional plans and the design of the regional marine reserves networks.

Over the last decade, and primarily under its broad marine planning responsibilities, the Department of Sustainability, Environment, Water, Population and Communities has been forging a collaborative relationship with Australia's marine science community, including Geoscience Australia, CSIRO, the Australian Institute of Marine Science and several universities and museums. The ongoing collaboration – currently funded under the Marine Biodiversity Hub of the National Environmental Research Program – represents a significant investment of public funds in the consolidation of marine biophysical and ecological data and knowledge and the development of tools to support decision-making.

The development of marine reserves, while underpinned by science, is strongly influenced by social and economic considerations. Marine reserves have the potential to result in significant access restrictions for a range of marine users, e.g. commercial and recreational fishers and offshore petroleum companies.

To build the capacity for integrating scientific input and socio-economic considerations, the department worked with conservation scientists from the University of Queensland to tailor existing conservation planning tools (MARXAN) to the specific needs of the marine bioregional planning program and to train departmental staff in the use of the tools. The tool provided a fast and powerful way to explore the implications of different configurations of marine reserves, in terms of their performance against the program's conservation and socio-economic cost minimisation objectives. It provided an important decision-support tool in working up options for consideration by government.

The department has also worked closely with fisheries scientists, social scientists and economists within the Australian Bureau of Agricultural and Resource Economics and Sciences to assess the impact of proposed marine reserves on commercial and charter fisheries in later stages of the planning process. This research informed the final reserve network designs by providing evidence of the potential impacts of the proposals before government for decision.

Source: Department of Sustainability, Environment, Water, Population and Communities

[54] Gluckman, P. (Sir). New Zealand's Chief Science Advisor to the Prime Minister. *Towards better use of evidence in policy formation: a discussion paper*. April 2011. 4.
[55] Gluckman. 2011. 5.

Working with uncertainty

Policy makers sometimes need to manage the risks associated with scientific uncertainty, including manage the conflicting, qualified or uncertain input provided by scientific experts. Science is by its very nature contestable and relies on a rigorous process of testing and re-testing to establish its credibility, authority and robustness. Furthermore, in areas that are complex or research is fast-moving, scientific evidence may be found that supports quite different, and even incompatible, approaches to resolving policy issues.

Any policy decision has to deal with uncertainty.[56] For policy makers, dealing with uncertainty and complexity is a routine aspect of policy development. Yet many policy makers find the issue of uncertain science to be vexing. The key issue here is cultural. There is a pervading view of science as objective truth. Yet many areas of science, including physics, mathematics, statistics and economics, accept that uncertainty is inevitable.[57]

There is also a common perception that more information will lead to less uncertainty, when it is just as likely that more information will introduce greater levels of complexity and new dimensions of uncertainty. This is especially likely in areas of complex policy. An "important aspect of uncertainty is that it is unlikely that everything will be known about the factors pertinent to a given issue or about how the factors interrelate".[58]

Policy makers therefore need to understand the nature and limitations of science (refer section 3). And, most importantly, need to have the skills to manage risk and uncertainty in scientific evidence. For example, there are skills to obtaining, analysing and balancing scientific information from many perspectives. Policy makers are already able to provide advice on complex issues in the absence of agreed or complete information. They need to be able to manage uncertainty in scientific analyses in the same way. In particular, policy makers need to be able to communicate clearly to decision makers, and the broader community, how different scientific viewpoints have been taken into account in developing options and coming to decisions.

The Australian Climate Change Science Program example below illustrates the challenges of dealing with uncertainties in natural science inputs, the need to draw on broader scientific fields, and the importance of effective science communication (Box 16).

[56] Bammer, G. and Smithson, M. *Uncertainty and Risk: Multidisciplinary Perspectives*. 2008. Earthscan Risk and Society Series, London. http://cpi.anu.edu.au/ripp/risk/2008-03_Uncertainty_Bammer_Smithson.pdf
[57] Bammer, G. and Smithson, M. *Understanding Uncertainty.* Integration Insights No. 7. May 2008. http://i2s.anu.edu.au/sites/default/files/overview/integration-insight_7.pdf
[58] Bammer and Smithson. *Uncertainty and Risk: Multidisciplinary Perspectives*. 2008. 4.

Box 16: Australian Climate Change Science Program

Science is fundamental in framing the public policy challenge of climate change. Rigorous and robust scientific assessment of the drivers and likely impacts of climate change is essential to inform costs and benefits of potential policy responses.

The Australian Climate Change Science Program, managed by the Department of Climate Change and Energy Efficiency (DCCEE), is the Government's dedicated climate change science research program, strengthening the evidence base for climate change policy. It has an overarching governance structure to advise on priorities, chaired by DCCEE, which brings together federal and state government policy advisors, publicly funded research agencies, and research scientists.

Many aspects of climate change science are well understood. However, there are inherent uncertainties in the science relating to the detection, attribution and projections of long-term trends in the highly complex and variable climate system. Information is often presented within bounds of uncertainty and decisions must be made that take a range of possible futures into account. This can make communicating climate change science to policymakers and the general public very challenging.

Accordingly, while delivering fundamental natural science understanding remains the core of this program, there is also an additional focus on effective science communication, incorporating engagement with broader scientific fields including behavioural and social psychology.

Source: Department of Climate Change and Energy Efficiency

Consultation

Early public engagement and communication on science issues can help ameliorate debates over the credibility of the science underpinning policy. The policy consultation phase should therefore seek to engage the broader community with the key scientific elements informing the policy options, as well as the science community. The science behind policy decisions needs to be understood and accepted by the public, especially where the policy is seeking to modify public behaviour or requires the public to adopt its outcomes. Clear communication of the scientific elements of a policy proposal is essential.

Policy makers need to find ways to engage and educate the general public on scientific matters of relevance to their policies. The National Enabling Technology Strategy (NETS) example below (see Box 17) demonstrates an innovative approach where the public were engaged in the science debate at the policy formulation stage, prior to the formal consultation phase.

For each policy development initiative, there would be value in planning engagement with the scientific and broader communities to facilitate the uptake of robust scientific evidence, to manage contested science and to effectively communicate the scientific elements of policy decision-making.

This project recommends that departments give early consideration to the appropriate science-policy interactions, including formal or informal advisory and consultation mechanisms, which will be required to support and facilitate the uptake of science in policy development (see recommendation 4.2).

Box 17: National Enabling Technology Strategy

In 2011, the National Enabling Technology Strategy (NETS) recognised the need to develop a new model for stakeholder consultations.

Traditional methods of consultation tended to be based on calling for submissions that attracted only the most vocal and highly-interested, then government trades off the requests made by conflicting groups to reach a policy decision. The downside of this approach is that direct engagement with stakeholders tended to empower a belief that their position would receive favourable treatment, resulting in criticism from all parties when their positions were 'traded-off' to reach a preferred position.[59]

A multi-stakeholder process was developed, using learnings from the 2008 Social Inclusion and Community Engagement on Nanotechnology workshop and best-practice engagement models from around the world, obtained at conferences and through published literature. The key principles behind the multi-stakeholder process were a two-step approach to stakeholder engagement and empowerment of stakeholders to make decisions. It also involved significant input from the otherwise disinterested public.

Full day workshops were held with each key stakeholder group, enabling them to clarify their positions and discuss issues of concern. The general public, however, who were recruited via a recruitment company, focusing on 'middle Australians' (excluding those either overly for or overly against new technologies) took part in a two-day workshop – which sought to diminish criticism from some non-governmental organisations (NGOs) that the general public were not knowledgeable enough to engage in such policy debates, and that NGOs best represented their interests.

This stage was designed as an inclusive, open listening exercise, exploring the range of views and developing preliminary lists of principles. Each workshop culminated in a report summarising the issues arising and a list of principles developed.

The crucial element was the second stage, where a small working group representatives from all key stakeholder groups came together for a one-day workshop. As all earlier workshop reports had been shared before hand there were more realistic understandings of different positions and perspectives and there was a strong emphasis on the need to develop an agreed upon outcome, which in this case was a public engagement framework. This focused the participants on outcomes.

Participants were highly motivated by being empowered to develop key elements of the framework themselves, and the undertaking that the outcomes would be put into practice. The process also enabled everybody's input to be heard and valued and gave equal weighting to different stakeholder inputs, with no one's input being of higher or lower value.

Importantly, the interest groups had to make the trade-offs on their positions themselves in order to reach an outcome.

Source: Department of Industry, Innovation, Science, Research and Tertiary Education

[59] A workshop on Social Inclusion and Community Engagement on Nanotechnology was held in 2008 that provided a useful first step in the learning process. It brought key stakeholders (Industry, Government, Non-Government Organisations, Researchers and the General Public) together to develop principles for public engagement. While the workshop did reach some agreement on key principles, it also highlighted that when diverse groups come together you cannot necessarily expect any change in their position. Many stakeholders clung to their positions more tightly when challenged by conflicting positions from other stakeholder groups.

5. Knowledge and data management

Knowledge management, integration and sharing within and across the APS and science agencies can facilitate access to and use of data and research services to support policy.

The timeliness of scientific evidence is integral to its uptake in policy development. The right evidence must be seen at the right time by the right people.

There is an opportunity for departments and science agencies to develop knowledge management strategies to facilitate timely access to and use of scientific data and research services to support policy (see recommendation 5.1). Such strategies should consider:

- identifying potential research and data needs for future policy
- considering data needs for evaluation and review in program design and/or implementation phases of policy development
- optimising data for wider use and data sharing across government
- ensuring policy makers and/or scientific staff have access to appropriate scientific resources (e.g. science journals and databases)
- promoting and utilising online data and research services
- establishing flexible procurement panel arrangements.

Publicly funded data across both government and the research sector could potentially be more openly accessible and re-usable to support further research and input to policy development. Recommendation 5.2 signals a potential project to further explore this opportunity to maximise government investment in Australia's scientific knowledge base for policy development and public benefit.

Recommendation 5.1
Departments and science agencies to develop knowledge management strategies, processes or practices that promote improved information management and facilitate access to scientific data, resources, expertise and advice.

Recommendation 5.2
Relevant agencies (e.g. OAIC, DIISRTE, GA, ABS), in conjunction with research organisations, to review current initiatives and, if appropriate, develop a project proposal for the management of publicly funded research data to facilitate data access, sharing and integration across the research and public sectors.

Strategic R&D planning

Prioritising research needs into areas of policy relevance can help ensure that policy makers will have access to the right evidence at the right time for future policy work. This theme was discussed in section 2 in relation to the Commonwealth setting research priorities for future policy work. However it can also be useful to consider future research and data at the departmental level, in the context of developing R&D strategic plans.

The Department of Education, Employment and Workplace Relations (DEEWR) considered future evidence needs in developing its 2011 research agenda, as detailed in Box 18, thus preparing the department for future policy work. The plan considers not only areas of knowledge, but also access to scientific capability and expertise.

Box 18: DEEWR's Research and Evaluation Plan

In developing its research agenda for 2011, the Department of Education, Employment and Workplace Relations (DEEWR) held discussions with the Melbourne Institute of Applied Economic and Social Research in early 2010 to identify potential research topics aligned with the department's Research and Evaluation Plan. This Plan aims to look beyond the horizons of immediate policy development to the evidence that will be needed to fill gaps in the department's knowledge and underpin the policy dialogues of the future.

This foresighting activity is formalised as part of the Social Policy Research Service agreement. This agreement enables the department to draw on the Melbourne Institute's significant statistical capability and expertise in analysing longitudinal data sets.

Source: Department of Education, Employment and Workplace Relations

The National Plan for Environmental Information (see Box 19) is a good example of a collective approach to planning evidence collection and management. The initiative is jointly led by the Bureau of Meteorology and DSEWPaC and aims to bring together national environmental information to assist future policy development and decision-making. The plan considers and prepares for environmental information priorities, as well as facilitating data access and sharing between government agencies.

Box 19: The National Plan for Environmental Information

The natural environment is vital to our wellbeing and that of future generations. Our landscapes, oceans, water, atmosphere and biodiversity play an important role in the economy – from agriculture and mining to energy production and tourism – and are fundamental to our Australian identity and way of life.

To manage this natural capital responsibly, governments, industry and the community need comprehensive, trusted and timely environmental information. Good information is essential for us to make sound decisions, individually and collectively, about the major issues affecting our natural assets.

The National Plan for Environmental Information initiative is an Australian Government program intended to improve the quality and accessibility of environmental information for decision-making. It is being jointly implemented by the Bureau of Meteorology and the Department of Sustainability, Environment, Water, Population and Communities.

The Bureau's role focuses on operational elements including Australian Government environmental information priority setting, and implementation of technical components of a functional environmental information infrastructure including the development of: environmental information systems; environmental information standards; products and services; and tools for improved data access and discovery.

The department's role focuses on establishment elements including introducing legislation, conducting a review of Australian Government environmental information activity, establishing jointly with the Bureau a high-level advisory group to provide whole-of-government direction and identifying priorities, and further developing the National Plan.

Source: http://www.environment.gov.au/npei/index.html and http://www.bom.gov.au/environment/NPEI_info_sheet.pdf

Data for evaluation

Scientific data as input is valuable throughout the policy process, but special consideration should be given to ongoing data for policy evaluation during the early planning phases. The Australian National Audit Office better practice guide on the implementation of program and policy initiatives supports early planning of policy implementation, including consideration of whether data supporting performance and progress reporting is sufficient for its purpose.[60] There is an opportunity to ensure that performance measures include tracking scientific indicators, particularly in social and environmental areas:

> "We need to ensure all government programmes are designed and funded with future evaluation and review in mind. That includes data needs, especially baseline data, and making explicit budgetary provision for that. We should be pushing harder for more and better data generally, particularly in the social and environmental areas.… data for policy evaluation needs to be recognised as a necessity – and a funding priority right now if we are serious about developing an evidence-based approach."[61]

Identifying appropriate measures is best done early, particularly in terms of establishing baselines for evaluating policy interventions. An additional consideration is that data management can be resource intensive and the cost of other scientific input can be unforeseen; portfolios need to ensure they have prepared for the resource impacts of policy implementation and evaluation when putting together new policy proposals.

Data sharing and integration

There are both challenges and opportunities in terms of access and sharing data. Data integration, or linking existing data sets, can provide valuable new insights to solve complex problems and support policy development. There is an opportunity to improve information management and sharing across the APS and the research sector to ensure that policy makers have access to, and make effective use of, existing scientific data.

In 2009, a Cross Portfolio Statistical Integration Committee (CPSIC) was established to provide strategic and collaborative leadership regarding the use of Commonwealth data assets in data integration projects for statistical and research purposes. CPSIC produced the High Level Principles for Data Integration, which state that "agencies should treat data as a strategic resource and design and manage administrative data to support their wider statistical and research use" (see Box 20). The principles also acknowledge the key risks and caution that consideration must be given to data security, privacy and confidentiality.

The ABS – as Australia's official national statistical agency – is well aware of the need to carefully manage the tensions between the growing emphasis on information sharing and concerns over maintaining privacy and confidentiality. [62] The ABS, along with other Commonwealth departments, recognises the benefits of information sharing and data linking. The ABS also has statutory obligations to maximise the use of administrative data, as set out in the core obligations outlined in the *Australian Bureau of Statistics Act 1975* (to avoid duplication and maximise use of information for statistical purposes). At the same time, the ABS and other Commonwealth agencies recognise the strong need to protect the personal information of individuals as set out in the *Privacy Act 1988*, and the confidentiality

[60] http://www.anao.gov.au/~/media/Uploads/Documents/implementation_of_programme_and_policy_initiatives.pdf
[61] Banks, G. *Challenges of Evidence-based Policymaking*. 2009. http://www.pc.gov.au/__data/assets/pdf_file/0003/85836/20090204-evidence-based-policy.pdf
[62] ABS Corporate Plan http://www.abs.gov.au

of data provided by individual businesses. The Australian Statistician currently chairs the Cross Portfolio Data Integration Oversight Board, which was established in March 2011 as part of the governance and institutional arrangements for data integration involving Commonwealth data.[63] The governance and institutional arrangements aim to build a safe and effective environment for data integration activities.

Box 20: High Level Principles for Data Integration

1. Responsible agencies should treat data as a strategic resource and design and manage administrative data to support their wider statistical and research use.
2. Agencies responsible for source data used in statistical data integration remain individually accountable for their security and confidentiality.
3. A responsible 'integrating authority' will be nominated for each statistical data integration proposal.
4. Statistical integration should only occur where it provides significant overall benefit to the public.
5. Statistical data integration must be used for statistical and research purposes only.
6. Policies and procedures used in data integration must minimise any potential impact on privacy and confidentiality.
7. Statistical data integration will be conducted in an open and accountable way.

Source: Australian Government, The. *High Level Principles for Data Integration involving Commonwealth Data for Statistical and Research Purposes*, 3 February 2010. http://www.nss.gov.au/

There are good examples of where data integration and sharing to support policy development and government decision-making is done well, including the National Plan for Environmental Information (see Box 19). In health policy, the Australian Institute for Health and Welfare (AIHW) has recognised expertise in building capability in data linkage in order to understand complex relationships in health and welfare.[64] AIHW's data linkage capability is underpinned by collaborative relationships and complex third party agreements with a range of other organisations, including other Commonwealth agencies (notably the ABS, DoHA and DFaHCSIA), state governments, universities and research centres, and international organisations.

The complexities of the relationships and agreements that underpin data sharing arrangements attest to some of the challenges in their establishment. However there are considerable benefits that accrue from understanding complex phenomena, particularly in terms of policy responsiveness. For example, the Attorney-General's Department's Critical Infrastructure Program for Modelling and Analysis uses confidential data provided by critical infrastructure owners and operators to construct close approximations of the geographic layout of physical assets, and the systems that connect them together – electricity, water, telecommunications, roads and railways. This data is used to develop modelling and analysis to assess the vulnerabilities and inter-relationships between critical infrastructure assets and systems, and what would happen if these broke down. The results of this work has contributed substantially to the evidence base for policies on national security, counter-terrorism and emergency management, infrastructure and community resilience, as well as assisted in crisis coordination in real time.

[63] http://www.nss.gov.au/dataintegration
[64] http://www.aihw.gov.au/

Publicly funded research data

There is an opportunity to develop a data sharing framework in Australia that covers both government and the research sector and treats publicly funded research data as a national asset to support public policy and further research. The Australian Government invests significant amounts in research and research data management. Outputs from publicly funded research could be made openly available, including to serve as inputs back to government as an end-user of research.

Such a framework would build on existing initiatives, including Australian Government investments in domain specific research data collection and management activities and national data management infrastructure, such as the Australian National Data Service (ANDS). ANDS is developing a cohesive national collection of research resources and a richer data environment that makes better use of Australia's research outputs, enables Australian researchers to easily publish, discover, access and use data, and enables new and more efficient research.

These arrangements are assisting government research agencies, such as GA, to make data available for researchers to explore for scientific purposes, which in turn, enhances the collective scientific understanding and the inputs available to policy makers.

> "Information is a valuable resource. The right information at the right time can expand knowledge, enable innovation, boost productivity, and even save lives. Unlike other valuable resources information is not diminished by use. Indeed, the value of information can be enhanced when it is openly accessible and reused frequently."[65]

An 'open access' framework for sharing publicly funded research data would build on and extend the Office of the Australian Information Commissioner's (OAIC) principles on open public sector information.[66] These principles establish that information held by Australian Government agencies is a valuable national resource that should – as a default position – be open to public access. A unified framework across the research and public sectors would give guidance to data-producing Commonwealth agencies, funding agencies and research organisations on the roles and expectations of publicly funded data collection, access, sharing and integration.

The project recommends that relevant agencies, in conjunction with research organisations, review current initiatives and, if appropriate, develop a project proposal for the management of publicly funded research data to facilitate data access, sharing and integration across the research and public sector (see recommendation 5.2). The relevant agencies are likely to include the OAIC, DIISRTE, ABS and a range of other policy departments (e.g. DoHA, DFaHCSIA), science agencies (e.g. GA) and, possibly, funding agencies (e.g. ARC and NHMRC).

A global trend towards data exploitation and sharing is increasing and can be seen in the policies of governments and research funding bodies such as the National Science Foundation and National Institutes of Health in the United States, the UK Research Councils, the European Union and Canada. In some cases, this includes explicit data management and sharing policies.[67] Australia's major funding agencies are already moving in the direction of

[65] Office of the Australian Information Commissioner (OAIC). *Issues Paper 2: Understanding the Value of Public Sector Information in Australia.* November 2011.
[66] http://www.oaic.gov.au/
[67] More information is available at http://biosharing.org/?q=policies

open access, with one agency encouraging researchers to make available the publications and data arising from funded work in accessible archives. However, while data is increasingly accessible, visibility is another issue.

There have been recent international policy statements in support of open access and, in particular, enhanced use of modern digital technologies to facilitate data access and sharing and open access to published research in scientific journals. For example:

- In the USA, the Obama Administration's Big Data Research and Development Initiative aims to advance and support the technologies required to collect, store, preserve, manage, analyse and share large quantities of digital data; to harness these technologies to accelerate the pace of scientific discovery and to expand the workforce needed to develop and use Big Data technologies.[68]

- The Royal Society (UK) issued a report in late June 2012 on *Science as an Open Enterprise*, which calls for the exploitation of the massive amounts of data now available in order to realise its potential for science and its application in public policy.[69] The report highlights key areas for action, including common standards for sharing information; greater recognition of the value of data gathering, analysis and communication; the need for technological tools and skills; and mandatory publishing of data in a reusable form.

- United Nations Educational, Scientific and Cultural Organization's *Policy guidelines for the development and promotion of open access* aims to provide guidance to member states on how to create an enabling policy environment for open access to scientific research from peer-reviewed journals.[70]

Scientific resources

It is important that policy makers have access to appropriate scientific resources to inform policy development at each phase, noting that there can be significant differences between agencies as to what is required.

The project found that a whole-of-government approach to accessing scientific journals is not likely to deliver savings, nor best meet the needs of different portfolios. However there is an opportunity for each department to consider how scientific resources are managed internally, including library services, and whether the efficiency and effectiveness of these services could be improved.

There may be opportunities for more limited consolidated procurements within portfolios with significant in-house scientific capability or across divisions in larger science agencies. For example, CSIRO has moved towards a consolidated approach internally to deliver efficiencies in the management of journal subscriptions.

Interestingly, librarian services within government agencies have evolved towards a focus on information brokering, rather than custodians or repositories of information. This role reflects the project's general finding that research translation and summation (i.e. a summary of the state of play in the science) is often the type of scientific input policy makers

[68] http://www.*whitehouse*.gov/sites/default/files/microsites/ostp/big_data_press_release_final_2.pdf
[69] http://royalsociety.org/policy/projects/science-public-enterprise/report/
[70] http://apo.org.au/sites/default/files/Policy_guidelines_open_access_Unesco_Swan_2012.pdf

require and that such input can be produced relatively quickly by the right people (see section 4).

In this regard, it may be appropriate for departments to invest resources in discovery tools, rather than in subscriptions to individual titles and indeed some agencies have reported a move away from subscriptions to 'purchase on demand'.

Some useful examples of free access online discovery tools for scientific resources are:

- The *Cochrane Library* is a collection of databases that contain high-quality, independent evidence to inform healthcare decision-making, which can be accessed by all Australian internet provider addresses (through a national licence managed by the NHMRC).[71]

- *Research Data Australia* is a portal to searchable web pages describing and linking to Australian research data collections, from both the research sector and the public sector, provided by ANDS.[72]

- *PolicyXPress* is a new online portal under development by the ANU's Institute of Public Policy, which will provide registered users with a unique search functionality and access to public policy relevant research and expertise. Registration will be available to all in the APS.[73]

- The Group of Eight's *Australia's Knowledge Gateway* is a search engine which identifies individuals and institutions with strengths in particular research disciplines, and facilitates contact with researchers who have the specific expertise and capabilities the user is looking for.[74]

- *Evidence Base* – an online journal published by Australia New Zealand School of Government which publishes reviews of the evidence informing decision-making in specific policy areas. Designed for public sector decision-makers, this journal is a 'broker' between the public sector, academics and other policy specialists.[75]

- *CSIRO's Data Access Portal* – CSIRO is making freely available 200,000 research papers dating back to the 1920s via its open-access repository.[76]

There would be value in departments considering the nature of the scientific resources most relevant to policy development in their areas and planning and resourcing appropriately.

Procuring science

There is an opportunity for departments to consider how the practical application of procurement, to obtain scientific inputs and advice, is managed within their portfolios and whether efficiencies could be achieved through planned procurement.

The process of accessing scientific input or advice through formal government procurement can be perceived as onerous or complicated by both policy makers and science suppliers. For

[71] http://www.thecochranelibrary.com/
[72] http://services.ands.org.au/
[73] http://publicpolicy.anu.edu.au/about_ipp/members/login.php
[74] http://gateway.go8.edu.au/
[75] http://journal.anzsog.edu.au/
[76] https://data.csiro.au/dap/home?execution=e1s1

example, PFRAs – as science suppliers – noted the need to negotiate contracts and intellectual property (IP) clauses with government departments as a potential, but not insurmountable, barrier. ARCom has been tasked, through its terms of reference, to consider possible barriers to research, such as intellectual property, warranties and indemnities, and the means of reducing transaction costs associated with engaging in research.

Nonetheless, the project found that no systemic tensions existed between the demand-driven needs of policy makers and the formal tendering, procurement and contract requirements. It would be valuable, however, for departments to ensure that policy makers are aware of best practice procurement principles and are able to plan procurement activities appropriately.

Where an agency expects to need to make regular purchases of goods or services, procurement panels are one approach used to achieve efficiencies in procurement practice.[77] Panels are suitable for sourcing scientific input from a range of suppliers on a planned and *ad hoc* basis during the development of a specific policy initiative. They can be established around a particular area of science (e.g. climate science) or technical expertise (e.g. computational modeling) or a combination of areas of expertise. In a panel arrangement, a number of suppliers are selected, each of which are able to supply identified goods or services to the agency. Suppliers are then asked to submit Requests for Quotation for specific services, as required, and can be engaged directly from Deeds of Standing Offer.

For example, in preparation for the development of NETS (see Box 17), DIISRTE established a procurement panel early in the policy development process. While the original process to establish the panel by open tender was time consuming, it was well worth the effort given that the department now has ready access to specialised areas of expertise to support ongoing policy work in enabling technologies. A key risk with establishing panels can be that the experts that the policy makers want to contract to undertake research do not tender, or are not successful when evaluated against the selection criteria. In this case, the NETS policy team sought to maximise the chances that the relevant suppliers would tender by advertising in targeted scientific journals, rather than relying solely on the AusTender listing.

Cooperative procurement arrangements, where panel arrangements are accessible by more than one agency can achieve even greater efficiencies, by reducing duplication and aggregating government demand.[78] For areas of shared scientific interest, agencies may also consider establishing a panel through a combined approach to market. Alternatively, any procurement panel arrangement can be set up to be open to other government agencies through 'piggy back' clauses.

A multi-use list (MUL) is intended for use in more than one procurement process and lists pre-qualified suppliers who have satisfied the conditions for participation for inclusion. An effective MUL provides agencies with an effective tool to streamline and simplify procurement processes when they regularly procure property and services with common elements. However, the process of establishing a MUL is not itself a procurement and agencies must still undertake a tender process (prequalified tender method) for procurements over the relevant threshold in the Commonwealth Procurement Rules (CPRs).[79]

[77] ANAO Audit Report. No. 31. 2011-12. *Establishment and Use of Procurement Panels*. http://www.anao.gov.au/~/media/Uploads/Audit%20Reports/2011%2012/201213%20Audit%20Report%20No%2031.pdf
[78] ANAO. 2011-12.
[79] http://www.finance.gov.au/procurement/procurement-policy-and-guidance/commonwealth-procurement-rules/

Agencies may also directly approach one or more potential science suppliers (limited tender method), where the proposed procurement is under the relevant threshold (usually $80,000) or meets the specified circumstance or exemption as specified in the CPRs.

Good practice principles for efficient, effective and accountable procurement of goods and services for government are readily available in the Department of Finance and Deregulation's *Buying for the Australian Government* guides.[80]

[80] http://www.finance.gov.au/procurement/procurement-policy-and-guidance/buying/

Part C. Appendices

Appendix 1. Abbreviations

AAD	Australian Antarctic Division
AAO	Australian Astronomical Observatory
AAS	Australian Academy of the Sciences
ABARES	Australian Bureau of Agricultural and Resource Economics and Sciences
ABS	Australian Bureau of Statistics
ACoLA	Australian Council of Learned Academies
AGIMO	Australian Government Information Management Office
AIATSIS	Australian Institute of Aboriginal and Torres Strait Islander Studies
AIHW	Australian Institute for Health and Welfare
AIMS	Australian Institute of Marine Science
ANDS	Australian National Data Service
ANSTO	Australian Nuclear Science and Technology Organisation
ANU	Australian National University
APS	Australian Public Service
APSC	Australian Public Service Commission
ARC	Australian Research Council
ARCom	Australian Research Committee
AusAID	Australian Agency for International Development
BITRE	Bureau of Infrastructure, Transport and Regional Economics
BoM	Australian Bureau of Meteorology
BREE	Bureau of Resources and Energy Economics
CCI	Coordination Committee on Innovation
CEO	Chief Executive Officer
COAG	Council of Australian Governments
CPRs	Commonwealth Procurement Rules
CPSIC	Cross Portfolio Statistical Integration Committee
CRCs	Cooperative Research Centres
CSIRO	Commonwealth Scientific and Industrial Research Organisation

CSTACI	Commonwealth State and Territory Advisory Council on Innovation
DAFF	Department of Agriculture, Fisheries and Forestry
DEEWR	Department of Education, Employment and Workplace Relations
DFaHCSIA	Department of Families, Housing, Community Services and Indigenous Affairs
DIISRTE	Department of Industry, Innovation, Science, Research
DoHA	Department of Health and Ageing
DSEWPaC	Department of Sustainability, Environment, Water, Population and Communities
DSTO	Defence Science and Technology Organisation
EBPN	Evidence-based Policy Network
EIF	Education Investment Fund
ERA	Excellence in Research for Australia
GA	Geoscience Australia
GO-Science	UK Government Office for Science
IGA	Inter-Governmental Agreement
IP	Intellectual Property
MRIs	Medical Research Institutes
MUL	Multi-use list
NERP	National Environmental Research Program
NETS	National Enabling Technology Strategy
NGO	Non-governmental organisation
NHMRC	National Health and Medical Research Council
NHPAs	National Health Priority Areas
NMI	National Measurement Institute
NRIC	National Research Infrastructure Council
NRM	National resource management
NRP	National Research Priorities
NSSIS	National Security Science and Innovation Strategy
OCS	Office of the Chief Scientist
OIAC	Office of the Australian Information Commissioner
PFRAs	Publicly Funded Research Agencies
PLI	Policy Liaison Initiative

PMSEIC	Prime Minister's Science, Engineering and Innovation Council
R&D	Research and Development
S&T	Science and Technology
UK	United Kingdom
USA	United States of America
WA	Western Australia

Appendix 2. Commonwealth science agencies

The following is a list and brief description of principal Commonwealth science agencies having substantial research expertise that provide scientific input to policy development.

Australian Antarctic Division (AAD)
The AAD undertakes major science programs and individual research projects to achieve Australia's key Antarctic science goals, which are periodically reviewed in line with national and global research priorities. Collaborative research programs are also conducted.

Australian Astronomical Observatory (AAO)
AAO is a division of the Department of Industry, Innovation, Science, Research and Tertiary Education, operates the Anglo-Australian and UK Schmidt telescopes on behalf of the astronomical community of Australia. Its function is to provide world-class observing facilities for Australian optical astronomical research.

Australian Bureau of Agricultural and Resource Economics and Sciences (ABARES)
ABARES is a research bureau within the Department of Agriculture, Fisheries and Forestry. It provides professionally independent, world-class research, analysis and advice to inform decision-makers on current and future policy challenges affecting Australia's primary industries. ABARES' capabilities in multi-disciplinary research and analysis span the fields of economics, science and social science covering the agriculture, fisheries, forestry and food sectors.

Australian Bureau of Meteorology (BoM)
BoM's research contributes to national social, economic, cultural and environmental goals. It has been Australia's national weather, climate and water agency for over 100 years and assists Australians in dealing with their natural environment, including drought, floods, fires, storms, tsunami and tropical cyclones.

Australian Bureau of Statistics (ABS)
ABS is Australia's national statistical agency. The ABS collects information through the Census, sample surveys and administrative data collections to provide official statistics on a wide range of economic, social and environmental matters. In addition to providing data to government agencies, researchers and the wider community, the ABS also analyses data and publishes research. This includes new analytical products and analysis services in areas such as modelling of data, data linkage, econometrics, time series analysis and analysis of socio-economic indexes.

Australian Institute of Aboriginal and Torres Strait Islander Studies (AIATSIS)
AIATSIS is the world's leading research, collecting and publishing institution in the field of Australian Indigenous studies. It aims to improve Australian and international knowledge of Aboriginal and Torres Strait Islander societies.

Australian Institute of Health and Welfare (AIHW)
AIHW is Australia's national agency for health and welfare statistics and information. AIHW collects and reports information on a wide range of topics and issues, ranging from health and welfare expenditure, hospitals, disease and injury, and mental health, to ageing, homelessness, disability and child protection. Governments and the community use the reports and data in discussing, debating, and making policy decisions on health, housing and community services matters.

Australian Institute of Marine Science (AIMS)
AIMS is a global leader in tropical marine science research. AIMS seeks to understand tropical marine ecosystems and the responses of these ecosystems to global changes. AIMS also supports the sustainable development of tropical marine based industries.

Australian Nuclear Science and Technology Organisation (ANSTO)
ANSTO has strong international collaborations with overseas counterparts and nuclear-focused multinational organisations which help leverage Australia's nuclear research capabilities, ensuring best practice, cutting-edge research and effective knowledge sharing. ANSTO scientists investigate areas as diverse as climate change, materials engineering, atmospheric monitoring and nuclear medicine.

Bureau of Infrastructure, Transport and Regional Economics (BITRE)
BITRE is part of the Policy and Research Division of the Department of Infrastructure and Transport. BITRE provides economic analysis, research and statistics on infrastructure, transport and regional development issues to inform both Australian Government policy development and wider community understanding.

Bureau of Resources and Energy Economics (BREE)
BREE is an economic research unit within the Department of Resources, Energy and Tourism. It provides independent, high quality economic research, data, analysis and advice to governments, industries and other stakeholders on issues affecting Australia's energy and resources sectors.

Commonwealth Scientific and Industrial Research Organisation (CSIRO)
CSIRO is Australia's national science agency and one of the largest and most diverse research agencies in the world. CSIRO manages national facilities and collections that are opened to researchers around Australia and overseas. CSIRO expertise is organised into divisions representing 15 research areas. CSIRO's 10 National Flagships address large-scale, long-term, multidisciplinary science to address Australia's major national challenges and opportunities.

Defence Science and Technology Organisation (DSTO)
DSTO is part of the Department of Defence. DSTO delivers expert, impartial advice and innovative solutions for Defence and other elements of national security. DSTO provides direct support to Australian Defence Force operations, supports the current and future force, provides advice throughout the lifecycle of the planning and development phases of Defence acquisition programs and conducts research to enable the development of future Defence capability. To meet the needs of Defence, DSTO leverages its relationship with the broader national and international scientific community and actively engages with industry and academia.

Geoscience Australia (GA)
GA exists to meet the geoscience information needs of the Australian Government and is custodian of the geological and geographic data of the nation. Its mission is to use geoscientific information and knowledge for economic, social and environmental benefit of Australia. GA's current emphasis is in the three main areas: the future energy and mineral resource base of the economy; providing geoscience input to a range of environmental issues; and contributing to community safety through research into natural hazards and their impact on society.

National Measurement Institute (NMI)

NMI is a research-based division of the Department of Industry, Innovation, Science, Research and Tertiary Education. NMI is Australia's peak measurement body responsible for biological, chemical, legal, physical and trade measurement. It delivers capability for measurement that increases national economic efficiency, enhances export trade prospects, and enables effective social and health policies.

Appendix 3. Project governance

Steering Committee members

Ms Patricia Kelly (Chair)
Deputy Secretary
Department of Industry, Innovation, Science, Research and Tertiary Education

Professor Ian Chubb AC
The Chief Scientist for Australia

Dr Subho Banerjee
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Department of Climate Change and Energy Efficiency

Dr Gordon de Brouwer
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Department of the Prime Minister and Cabinet

Mr David Butt
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Department of Health and Ageing

Mr Phillip Glyde
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Mr John Gunn
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Mr David Parker
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Dr Chris Pigram
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Ms Deb Callister
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Dr David Cunningham
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Individual contributors

The following individuals are acknowledged as contributing independent external advice and/or content to the project.

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Case study contributors

The following is a list of the organisations who contributed to the evidence base through case studies or other exemplars.

Attorney-General's Department

Australian Building Codes Board

Australian Bureau of Statistics

ANU Institute of Public Policy (including the HC Coombs Policy Forum)

Australian Nuclear Science and Technology Organisation

Commonwealth Scientific and Industrial Research Organisation

Defence Science and Technology Organisation

Department of Agriculture, Fisheries and Forestry

Department of Broadband, Communications and Digital Economy

Department of Climate Change and Energy Efficiency

Department of Education, Employment and Workplace Relations

Department of Health and Ageing

Department of Industry, Innovation, Science, Research and Tertiary Education

Department of Regional Australia, Local Government, Arts and Sport

Department of Sustainability, Environment, Water, Population and Communities

Geoscience Australia

National Measurement Institute

Targeted consultations

The following is a list of all of the organisations interviewed or consulted on the project. In some cases an individual from the listed organisation was interviewed in their personal capacity, rather than as a representative of the organisation.

Australian Bureau of Statistics

Australian National Data Service

Australian National University

Australian Nuclear Science and Technology Organisation

Australian Public Service Commission

Australian Research Council

Biosecurity Advisory Council

Bureau of Meteorology

Centre for Australian Weather and Climate Research

Council of Australian Governments Reform Council

Cooperative Research Centres Association

Commonwealth Scientific and Industrial Research Organisation

Defence Science and Technology Organisation

Department of Agriculture, Fisheries and Forestry

Department of Climate Change and Energy Efficiency

Department of Health and Ageing

Department of Industry, Innovation, Science, Research and Tertiary Education

Department of Sustainability, Environment, Water, Population and Communities

Food Standards Australia and New Zealand

Group of Eight

National Health and Medical Research Council

University of Canberra

University of Queensland

University of South Australia

University of Tasmania

Appendix 5. Science advisory mechanisms

There are many mechanisms for obtaining scientific input available to policy makers, both formal and informal. Policy makers need to obtain scientific advice under different time frames, depending on the stage of the policy process and the type of policy. The challenge for policy makers is to determine the most appropriate mechanism(s) to use.

In-house capability

Developing in-house capability to provide scientific input is one mechanism available to policy departments. Departments with embedded science agencies take this approach. Policy departments may also seek to recruit or identify existing staff with science backgrounds or key scientific skills (see Part B – section 3).

Appointed high level science advisors within portfolios (e.g. the Chief Scientist, Chief Statistician, Chief Defence Scientist, Geoscience Australia Chief Scientist, etc.) have the capacity to provide high level independent advice to government. They are valuable embedded positions within the Australian science system, often called upon to provide advice directly to Ministers.

In-house capability is potentially accessible at all stages of the policy cycle. While establishing in-house capability is a formal process (e.g. recruitment or secondments), utilising this capability for policy development may be undertaken informally, through internal networks and *ad hoc* requests, or formally through internal committees, taskforces or working groups.

For example, DSTO established a dedicated in-house working group from across relevant areas to support the development of the Defence Space Science and Technology (S&T) Policy in 2011. This approach provided policy makers with ready access to scientific input and advice throughout the policy development process (Box 10).

Commissioned research

Policy makers may commission scientific research to support policy development. Research may be commissioned through grants or procurement. Policy makers may commission research by a number of different third parties with the relevant expertise to undertake the work, usually individuals, research agencies, universities, consultants or other research organisations. A key consideration when commissioning research is confidence in the science supplier to provide input or advice that is credible, honest and based on robust scientific research. It is important to ensure that policy makers and science providers have agreed on the parameters for the research at the start and continue to engage at regular opportunities to check ‘fit-for-purpose’ expectations.

Commissioned research is a formal contractual approach to obtaining scientific advice and the timeframes sometimes associated with policy development can prove challenging. In the case of procured contract research, there are processes which can support timely access, such as establishment of procurement panels and standardised clauses regarding indemnities, IP and warranties (see Part B – section 5).

Scientific research may be commissioned to support policy development at most stages of the policy cycle. For example, The Chief Scientist has commissioned the Learned Academies (through ACoLA) under the Securing Australia’s Future Program (see Part B – section 2) to support both policy anticipation (issues identification) and formulation (gathering

information to develop policy options). Commissioned scientific research may also be used to inform policy evaluation (e.g. social, environmental and economic impact studies).

Consultations (submissions)

Consultations may be considered to be science advisory mechanisms where they are explicitly used to obtain scientific input or advice.

Consultation can occur both formally and informally. Formal consultation mechanisms include: invitations to make submissions in response to the public release of an issues paper; exposure draft consultations internal to the APS; or consultations through open or closed forums. Formal consultations are most common after initial policy formulation has taken place and serve to test policy options, prior to presentation to a decision-maker, or as part of policy evaluation (e.g. reviews and parliamentary enquiries). Consultations may occur throughout the policy cycle and usually involve interacting through formal or informal networks.

For the purposes of obtaining scientific input or advice, submissions in response to formal consultation processes are a useful mechanism if the scientific elements of the policy options have been clearly noted in the issues paper and submissions are received from credible independent experts. For example, the Australian Academy of Science (AAS) utilises the expertise of its fellowship and 22 disciplinary-based national committees to develop and provide submissions to government on science policy issues.

Advisory bodies

Advisory committees or other formal advisory bodies (e.g. expert groups, review panels) that include respected members of the scientific community are valuable mechanisms for obtaining scientific input or advice at all stages of the policy cycle.

Advisory bodies may be established on a standing or temporary basis and may provide broad-ranging or subject specific advice. For example, PMSEIC is a standing body which provides high level independent advice on broad-ranging science, engineering and innovation issues.

The Basin Salinity Management Strategy Working Group, on the other hand, was a subject specific temporary body established to investigate ways to reduce the load and impact of salt in the Murray River main channel, convened by the Murray-Darling Basin Commission during its policy formulation stage. It was succeeded by the Basin Salinity Management Implementation Working Group for the implementation phase.